DOCUMENT RESUME

ED 170 978 EC 114 711

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TITLE Children on Medication: A Primer for School Personnel.
INSTITUTION Council for Exceptional Children, Reston, Va. Information Services and Publications.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
PUB DATE 79
NOTE 116p.; A Product of the ERIC Clearinghouse on Handicapped and Gifted Children
AVAILABLE FROM The Council for Exceptional Children, Publication Sales Unit, 1920 Association Drive, Reston, Virginia 22091 ($7.50, Publication No. 191)

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS *Behavior Change; Drug Education; *Drug Therapy; Epilepsy; *Handicapped Children; Hyperactivity; Mentally Handicapped; School Personnel; *Sedatives; *Stimulants

ABSTRACT

Intended as a primer for school personnel, the book discusses children whose various disorders require them to be on medication, and describes the behavioral effects of these drugs along with their major side effects. Fundamental concepts in pharmacotherapy are reviewed, including dosage adjustment and side effects, and a brief introduction to the different kinds of drugs is presented. Research investigating the effects of stimulants (Ritalin, Dexedrine, and Cylert) on activity level, perceptual-motor skills, learning performance, behavior problems, and school achievement of hyperactive children is reviewed. Nonstimulant drugs occasionally used in the treatment of hyperactivity are also mentioned, and the Feingold diet and behavior modification are briefly described. The various types of epilepsy are examined, along with the drugs used to treat them. Also covered are febrile seizures, the management of seizures in the classroom, and how antiepileptic drugs can affect classroom performance. The use of major tranquilizers in the treatment of behavior disorders associated with mental retardation is described. Other topics covered include the use of psychotropic drugs in the treatment of enuresis, school phobia, cerebral palsy, and childhood psychosis. Included in the appendixes are a classification of psychotropic drugs, a classification of the epilepsies, and Conners' Abbreviated Teacher Rating Scale. A glossary is also included. (DLS)

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children on medication:
a primer for school personnel

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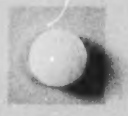
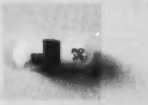
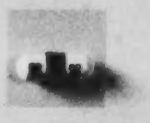
Children's Medication Chart

Developed by Kenneth D. Gadow and Robert L. Sprague

This chart is intended for purposes of survey identification *only*.	1 Atarax® (10 mg)	2 Atarax® (25 mg)	3 Atarax® (50 mg)	4 Benadryl® (25 mg)
5 Benadryl® Kapseals® (50 mg)	6 Colontin® Kapseals® (0.15 g)	7 Colontin® Kapseals® (0.3 g)	8 Dasnor® (25 mg)	9 Desedrine® (5 mg)
10 Desedrine® Spansule® (7 mg)	11 Desedrine® Spansule® (15 mg)	12 Diamox® (125 mg)	13 Diamox® Sequels® (500 mg)	14  Diamox® (250 mg)
15 Dilantin® Kapseals® (30 mg)	16 Dilantin® Kapseals® (100 mg)	17 Dilantin® Infatabs® (50 mg)	18  Dilantin® with ¼ grain Phenobarbital Kapseals®	19  Dilantin® with ½ grain Phenobarbital Kapseals®
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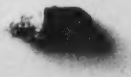
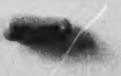
25  Eskabarb® Spansule® (87 mg)	26 Gamonil® (100 mg)	27 Libritabs® (5 mg)	28 Libritabs® (10 mg)	29  Librium® (5 mg)
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kenneth d. gadow

The Council for Exceptional Children

ERIC A product of the ERIC Clearinghouse on Handicapped and Gifted Children.

Published in 1979 by The Council for Exceptional Children, 1920 Association Drive, Reston, Virginia 22091

Library of Congress Number 79-51024

The material in this publication was prepared pursuant to a contract with the National Institute of Education, US Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their judgment in professional and technical matters. Prior to publication the manuscript was submitted to The Council for Exceptional Children for critical review and determination of professional competence. This publication has met such standards. Points of view, however, do not necessarily represent the official view or opinions of either The Council for Exceptional Children or the National Institute of Education.

Printed in the United States of America.

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About the Author

Kenneth D. Gadow is an Assistant Professor in the Special Education Program at the State University of New York at Stony Brook. He completed his undergraduate and graduate studies at the University of Illinois receiving a B.S. degree in psychology, M.Ed. in early childhood special education, and Ph.D. in special education. His experience in education includes classroom teaching, inservice training, consulting, and teacher preparation. Dr. Gadow studied pediatric psychopharmacology at the University's Institute for Child Behavior and Development and became involved in drug research on hyperactive and mentally retarded children. He has served as a member of the Board of Directors of the Illinois Epilepsy Association.

Dr. Gadow has directed three statewide studies of special education programs in Illinois to determine the pattern and prevalence of drug use and school involvement in drug therapy. The results of these studies have led him to believe that there are serious problems in the delivery of services to children who receive medication. Two of the major problems teachers encountered were exclusion from a meaningful role in what should be a team effort and less than adequate training about pharmacotherapy. In response to the latter, he and Dr. Robert L. Sprague developed one of the first comprehensive courses about medication and exceptional children offered in a College of Education. The two also collaborated on the development of an inservice training institute for The Council for Exceptional Children entitled "Drug Therapy with Children." Dr. Gadow's current research activities include a followup study of hyperactive children treated with stimulant drugs. Some of the variables being investigated are drug abuse, reactions to taking medication, delinquency, and the impact medication has had on the child and family.

Acknowledgments

I would like to thank the following people for reading preliminary drafts of various chapters and making valuable textual suggestions: Laurence Becker, Ph.D., Associate Professor of Pediatrics, University of California School of Medicine, Irvine; Mary Coleman, M.D., Clinical Assistant Professor, Georgetown School of Medicine, and Director, Children's Brain Research Clinic, Washington, D.C.; Frederick Green, M.D., Children's Hospital, Washington, D.C.; Leila Roberts, School Nurse, Lansdowne Middle School, Maryland; Esther Sleator, M.D., Institute for Child Behavior and Development, University of Illinois at Urbana-Champaign; Robert L. Sprague, Ph.D., Director, Institute for Child Behavior and Development, University of Illinois at Urbana-Champaign; Bertrand Winsberg, M.D., Director, Division of Child Mental Health, Long Island Research Institute; and Sheila Wolfe, O.T.R. I am grateful to Samuel Livingston, M.D., for permission to reprint various tables and for providing me with the latest research from his Epilepsy Diagnostic and Treatment Center. I would also like to thank Merle B. Karnes, Ed.D., for her role in making this book possible.

I am very grateful to the literally hundreds of teachers and parents in Illinois who supplied the necessary information to describe therapeutic drug use patterns among children in special education programs and to the Directors of Special Education, school administrators, and school nurses who made these data collection efforts possible. A special thanks is extended to my interviewers, Jan Knecht, Tobey Fumento, and Norma Wilson.

I am much indebted to Dr. Irv Bialer, Research Scientist, Division of Child Mental Health, Long Island Research Institute, who generously provided editorial assistance in revising preliminary versions of all chapters. The completion of this book was made much easier by his skillful efforts.

I wish especially to express my appreciation to my colleagues at the Institute for Child Behavior and Development, Robert L. Sprague and Esther Sleator, for their encouragement and support over the past five years.

Kenneth D. Gadow

Introduction

The use of drug therapy in the management of childhood behavior disorders has received much attention in recent years. One can walk into almost any public school, and, after engaging teachers and staff in a conversation about children and medication, discover that this is quite a controversial topic. Such discussions not only reveal a considerable interest in medication but also a variety of problems associated with drug therapy. Unfortunately, it is difficult for people outside the medical professions to learn about the therapeutic use of drugs. It is not unusual, therefore, that many teachers are poorly informed about medication. This lack of knowledge is often accompanied by uncertainties and misconceptions that are created, in part, by sensational articles aimed at parents and teachers.

The fact that researchers and clinicians simply do not know all the answers to frequently asked questions about drug treatment also complicates matters. Highly biased articles both for and against drug treatment have fueled a bitter controversy over the use of medication for childhood behavior disorders. Because little is known about the origin(s) of behavior disorders (and many other maladies as well), a number of prophets have surfaced willing to lead us to the truth. They have claimed that everything from bad lighting to tight underwear is the cause of behavioral disturbance. In the center of this confusion, controversy, and uncertainty are the family and school trying to figure out what is the best thing to do for their children. And, they are not always in agreement.

WHY LEARN ABOUT DRUG TREATMENT?

The use of medication in the management of learning, behavior, and convulsive disorders is of interest to school personnel for several reasons. First, the very behaviors that are affected by drugs are often interrelated with the educational process. For example, the symptoms that characterize behavior disorders can interfere with the child's ability to benefit from instruction, as well as hinder the teacher's efforts to teach other children in the class. Physically aggressive acts can actually place the welfare of both teacher and peers in jeopardy.

Similarly, uncontrolled seizures can be a serious impediment to learning for the child with epilepsy. If the attacks are frequent or severe, the amount of time spent on instruction can be greatly limited. Seizures in the classroom can be quite disruptive for peers as well if the situation is not handled appropriately. Because these chronic childhood disorders often precipitate serious emotional problems, the teacher can become involved in another aspect of school learning—social development. Another way learning and behavior problems become a part of the teaching process is when they are identified as instructional objectives. This is particularly true in special education settings.

Second, medication is of interest to teachers because the drugs used in the management of these disorders have a pronounced effect on behavior. In some children, medication suppresses behavior that is perceived by caretakers as incompatible with accepted standards. For other

children, drug therapy appears to make them more responsive to their environment by enhancing cognitive abilities. Parents comment, for example, "The child is easier to manage," "You can get through to him now," or "He can sit still long enough to read to" (Gadow, 1977b). Also of importance to the teaching situation are the side effects of medication. Although many side effects are benign or eventually go away, others can be quite alarming if those responsible for the child's care are unprepared for what to expect. When side effects impair classroom performance or create emotional problems, they are not only distressing to teachers and parents but raise serious risk-to-benefit questions.

Third, studies have shown that relatively large numbers of school children are on medication for hyperactivity, behavior problems, and epilepsy. In fact, only a small percentage of teachers have not had students who were receiving medication for one of these problems. Exposure to pharmacotherapy is much greater for teachers in special education programs, particularly those for mentally retarded, emotionally disturbed (behavior disordered), and learning disabled children.

Finally, studies of treatment procedures for hyperactive children have clearly demonstrated the importance of school participation in drug treatment. Teachers can be helpful by providing the child's physician with behavioral evaluations during the diagnostic, dosage adjustment, and followup phases of drug treatment. Reports of side effects observed in the classroom are also valuable. Because medication does not teach the child anything, many children with learning and behavior problems will require educational programing as part of the total treatment plan. It has been my experience that teachers are often interested in therapeutic measures concomitant with their own instructional efforts. The effective management of other chronic childhood disorders that respond to medication also involves the school. For example, teachers can provide useful diagnostic and drug response information for physicians about epileptic and mentally retarded children.

OBJECTIVES OF THIS PRIMER

After conducting three statewide studies about how medication was being used with exceptional children, I realized that teachers were interested in drug treatment and were concerned about a number of problems. Among other things, teachers indicate that they:

1. Are not well informed about the use of medication.
2. Are excluded from what should be a team effort.
3. Have little direct contact with the doctor.
4. Are disturbed by side effects and overmedication.

Perhaps the greatest single problem is a lack of information about drug treatment. Teachers have many questions about what medication is supposed to do to help children, side effects, whether drugs can interfere with learning, dosage, what teachers should do in various situations, drug interactions, and what kinds of drugs are used for specific disorders.

Because there are few comprehensive references for parents and teachers about drug treatment, this primer was developed to answer these and other questions about children on medication. It must be emphasized that making drug information available in this format does *not* imply that caretakers should preempt a medical role. School personnel should not make medical diagnoses or recommend to parents that their child should be placed on medication. It is generally agreed, however, that teachers can be helpful to physicians by providing much needed feedback about the response to treatment. The school is but a part of a team effort that involves the family, health professions, psychological services, and social welfare agencies. It is hoped that by making drug information available to parents and nonmedical professionals, they will be more effective in participating in an interdisciplinary treatment effort.

The primary focus of this primer is a description of the behavioral effects of drugs and the major side effects observable to teachers and parents. Although questions are frequently asked about how medication acts on the body to produce certain behavioral changes, this topic is not discussed here. A lack of understanding on the part of the reader about how a drug works should not interfere in any way with the expressed objectives of this text.

Of equal importance to discussing drug related changes in behavior is describing how doctors use medication. This includes typical dosages, the time of day medication is taken, how long treatment will last, and under what circumstances medication is terminated. This is much

more difficult than it sounds because few people study the behavior of physicians (or teachers for that matter). Although there are many statements of clinical experience in the literature or "how to" articles, there is often a disparity between what experts say should be done and what really happens in everyday situations. In order to create a more realistic picture of actual practices, the available data on everyday medical procedures are included in the text.

Even though there is a technology of teaching, the effective use of instructional techniques is an art. Like fashion, medical technology is also an art. Physicians, like teachers, develop a variety of ways for handling similar problems based upon the responses of previous patients. The reader is cautioned, therefore, that the descriptions of medical practice presented in this text are not necessarily what one might encounter or what one should expect.

By definition, a primer is an introduction to a specific area of inquiry and, therefore, must be limited in both depth and detail. In order to present a more thoughtful discussion on medication, some topics had to be omitted. Exclusion of a particular topic does *not* imply a value judgment about worth or importance, but simply a practical consideration. Although the reader is provided with a description of each disorder, I have not attended to etiological questions or diagnostic procedures. The necessary focus on medical intervention has precluded any explanation of the social-emotional problems associated with chronic childhood disorders. Hopefully, this will not obscure the importance of *psychosocial* factors in the etiology, response to treatment, and long term therapeutic outcome of behavior and convulsive disorders. What may to some seem an even greater oversight is my exclusion of alternative treatment procedures. It would be truly unfortunate to infer from this decision that drug therapy is the sole treatment for learning and behavior disorders or even the best method for all or most children. Because many books and articles are available about nonmedical techniques, it seemed unnecessary to review them here. Instead, publications discussing alternative measures are cited as references.

Undoubtedly, many readers will be interested not only in information about drug effects, but also in ways of handling different problem situations that often arise with children on medication. Because few guidelines are available from either local, state, federal, or private agencies, teachers are often uncertain about what they should or should not do. Examples of ways in which school personnel can help the physician adjust dosage and monitor treatment are covered in Chapter 1. However, this is only a brief overview of several aspects of a complicated topic. Unfortunately, the focus of the text and space limitations prevent a detailed discussion of the role of school personnel in drug treatment.

ORGANIZATION OF THE TEXT

The general outline of the primer is as follows. In the first chapter, I have explained some of the fundamental concepts and terms relating to drug therapy. Each of the following chapters covers the use of medication with regard to specific childhood disorders. When available, prevalence figures are reported for the given disorder and for the use of drug therapy in the general school population and in special education programs. Both therapeutic and side effects of the drugs employed are described, along with pattern of treatment. The latter includes age at which medication is started, dosage, when during the day medicine is administered, how long treatment will last, and drug combinations. Because drugs typically have many properties, they are often used in the management of more than one disorder. To prevent the redundancy that would result from describing the same drug in different chapters, only the primary drugs associated with the treatment of each disorder are discussed.

Because each chapter is an overview of drug treatment, a list of suggested readings is provided at the end of each chapter for those interested in pursuing a topic in greater depth. Each item in the list is coded for the audience for which it is most appropriate: P = parent, T = teacher, and M = medical personnel. Please note that many items in the last category are suitable for graduate level students in special education.

To repeat, by no means should this primer be misconstrued as implying that school personnel should assume the role of a physician. However, if it enables parents and nonmedical professionals to ask more intelligent questions during interdisciplinary interaction and to focus more clearly on educational issues, then this text will have fulfilled its purpose. It is hoped one byproduct of this increased awareness will be better instructional decisions for the child, the true objective of our efforts as educators.

Chapter 1: Fundamental Concepts in Pharmacotherapy

The first chapter is a brief introduction to the differet kinds of drugs that are used to effect changes in mood, thought processes, and behavior. Central to an appreciation for the complexity of drug treatment is a basic understanding of the way drugs move through the body. Other topics include dosage adjustment, drug interactions, tolerance, and side effects. Using the treatment of hyperactivity as an example, an argument is made for the importance of school participation in drug therapy.

Chapter 2: Hyperactivity

The most common childhood disorder for which pyschotropic drugs are prescribed is hyperactivity. *Hyperactivity* is defined as a persistent developmental pattern characterized by excessive motor restlessness and inattentiveness. The latter may be the most important feature of the disorder. Other behavioral symptoms are frequently associated with hyperactivity, including poor school achievement, conduct problems, immaturity, impulsivity, and peer difficulties. In this chapter, research investigating the effects of stimulants (Ritalin, Dexedrine, and Cylert) on activity level, perceptual-motor skills, learning performance, behavior problems, and school achievement is reviewed. The discussion includes studies that investigated the effects of various doses of Ritalin on different types of behavior. Nonstimulant drugs occasionally used in the treatment of hyperactivity are also mentioned. The results of long term followup studies on hyperactive children are summarized. Research on two nondrug treatments, the Feingold diet and behavior modification, is described briefly.

Chapter 3: Convulsive Disorders

Convulsive disorders can be separated into the following five categories: grand mal (major motor), petit mal (absence), psychomotor (temporal lobe), myoclonic, and autonomic. These forms of epilepsy typically differ from one another in terms of what the seizures look like, age when attacks usually begin, and type of drug that is most effective in controlling the seizures. The main focus of this chapter is a description of the various types of epilepsy and the drugs used to treat them. Other topics include febrile seizures, the management of seizures in the classroom, the circumstances under which drug treatment is terminated, and how antiepileptic drugs can affect classroom performance. Because many children with epilepsy receive two or more drugs per day, drug interactions are also discussed.

Chapter 4: Mental Retardation

Drug treatment for behavior disorders, epilepsy, and cerebral palsy is much more common among mentally retarded children in comparison to their nonretarded peers. Surveys show that stimulants are the most commonly prescribed drugs for behavior disorders in mentally retarded children in public school programs while major tranquilizers are the preferred agents in residential facilities. Some of the commonly reported reasons for administering medication are the control of hyperactivity, aggressive outbursts, self injurious acts, and stereotyped movements. This chapter describes the use of major tranquilizers (e.g., Thorazine, Mellaril, and Stelazine) in the treatment of behavior disorders associated with metal retardation. Many of the issues concerning psychotropic drugs and mental retardation are discussed including recent litigation.

Chapter 5: Other Disorders

The final chapter briefly describes the use of psychotropic drugs for enuresis, school phobia (separation anxiety), cerebral palsy, and childhood psychosis. The antidepressant Tofranil has been used with some success in the treatment of enuresis (bedwetting) and school phobia. The two most commonly prescribed skeletal muscle relaxants for cerebral palsy are Valium and Dantrium. A variety of drugs have been used to treat childhood psychosis, but the major tranquilizers are generally considered the most effective agents at the present time.

1/Fundamental Concepts in Pharmacotherapy

Pharmacology is the study of the chemical and physical properties of drugs; the effects of drugs on body chemistry, physiology and behavior; the mechanisms of action; the movement of drugs into, around, and out of the body; and their use in the treatment of medical disorders. One major subdivision of this science is *neuropharmacology* which investigates the effects of drugs on the nervous system. As stated in the introduction, this topic is not covered here. However, the reader is referred to Oakley S. Ray's *Drugs, Society, and Human Behavior* (1974) for an excellent discussion of how drugs used to modify behavior alter the functioning of nerve cells, certain areas of the brain, and the autonomic nervous system. A second major division is *psychopharmacology*, the study of how drugs affect behavior. Broadly defined, behavior includes thinking, feelings, mood, perceptions, motor activities, etc. Because the bodies of children differ in many ways when compared to adults, there is a separate science concerning the behavioral effects of drugs in children. This is known as *pediatric psychopharmacology*. The primary focus of this text is on the latter.

There are approximately 10,000 prescription drugs available to American physicians, and an additional 100,000 products can be purchased without a prescription (Silverman & Lee, 1974). Of the prescription medicines, two categories are of particular interest here because they have pronounced effects upon behavior and are used frequently in treating chronic childhood disorders. These are the *psychotropic* and *antiepileptic* drugs.

Drugs that are prescribed primarily for their effect on mood, thought processes, and behavior are collectively referred to as psychotropic drugs. A number of different classification schemes have been used to subdivide this category of drugs, and a variety of labels are used in the literature to describe given subcategories (Leavitt, 1974; Usdin, 1970). To minimize confusion, the psychotropic medications discussed in this text have been grouped according to six categories proposed by Usdin and Effron (1972). These are *stimulants, major tranquilizers, minor tranquilizers, antidepressants, hypnotics,* and *sedatives*. An extensive listing of the drugs in each of these categories appears in Appendix A. A seventh category of psychotropic agents, the *hallucinogens*, have not proven effective in the treatment of childhood disorders.

Anticonvulsant or antiepileptic drugs, as the names imply, are used in the management of convulsive disorders. This class of drugs can be further subdivided according to similarities in chemical structures (see Table 3–2). Because many psychotropic drugs have anticonvulsant properties, there is considerable overlap between these two groups. To simplify matters, drugs used primarily for convulsive disorders will be referred to as anticonvulsants and the rest as psychotropics. It would be inappropriate, however, to infer the reason for which a drug is prescribed from its assigned categorical label. For example, the antidepressant Tofranil (imipramine) is used not only in the management of depression, but also to treat panic anxiety (Honigfeld & Howard, 1973), enuresis (Blackwell &

Currah, 1972), hyperactivity (Rapoport, Quinn, Bradbard, Riddle, & Brooks, 1974), separation anxiety (Gittelman-Klein, 1975), and convulsive disorders (Fromm, Amores, & Thies, 1972).

To add to the confusion, drugs have both a *generic* name and a *trade* name. The generic name is typically used in the medical literature and is employed by the scientific community throughout the world. The trade name, however, is a registered trademark and is controlled by the manufacturer indefinitely. It is not unusual for a drug company to market the same drug under different trade names depending upon the country in which it is distributed. When a company receives a patent on a new drug, it controls the right to manufacture that agent for 17 years. After the patent expires, any company can manufacture the drug under the generic name or a new trade name. The generic name is often a polysyllabic word that is easy to stumble over. For example, the generic name for Ritalin is methylphenidate hydrochloride. Because most prescriptions are written by trade name including drugs no longer protected by a patent (Silverman & Lee, 1974), teachers typically encounter trade names when asking parents about their child's medicine or searching through school medical records (Gadow, 1976; 1978a). It is for this reason that drugs are referred to by trade name in this primer. In the case of drugs that are no longer protected by a patent, the original trade name is cited. After the first mention of a drug in each chapter, the generic name appears in parentheses.

A considerable degree of controversy has been generated over generic products, i.e., drugs for which the patent has expired and are being sold by companies other than the original patent holder (Silverman & Lee, 1974). Because generic products are often sold at a lower price than the original trade name product, strong arguments have been made for more widespread use of generic drugs (Burack & Fox, 1975). In many states, the pharmacist can fill a doctor's prescription with the least expensive generic product unless the physician specifies no substitutions (Sonnenreich & Menger, 1977). (The actual guidelines for making substitutions vary from state to state.) The patient, of course, can always ask the doctor to write the prescription using the generic name if generic products are available. For this and other reasons, an extensive list of pyschotropic and antiepileptic drugs by trade name appears in Appendix E along with the corresponding generic name. This listing is by no means complete since foreign trade names have been excluded. Also, some of these drugs are now available under several different trade names in the United States alone. In such cases, the inclusion of trade names other than the original was arbitrary. A list of drugs by generic name is also available (see Appendix D). This should be of some assistance to those unfamiliar with generic names when searching the medical literature for drug information.

PSYCHOTROPIC DRUGS

Stimulants are among the most frequently prescribed psychotropic drugs for children and are used primarily for the management of hyperactivity. This group includes Ritalin (methylphenidate), Dexedrine (dextroamphetamine), and Cylert (pemoline). These drugs are occasionally used in the treatment of certain types of epilepsy and may be administered to control drowsiness, which is a side effect of some anticonvulsant drugs. Stimulants are also used to treat *narcolepsy*, a disorder characterized by sudden attacks of sleep during normal waking hours. However, narcolepsy is an uncommon disorder and rarely develops in children under 12 years of age. The effect of stimulants on the behavior of children is discussed in Chapter 2.

Major tranquilizers are typically administered to control bizarre behavior in psychotic adults. These drugs are also referred to as *neuroleptics* and are more appropriately named *antipsychotic* agents. The term *major tranquilizer* was adopted here because it is more widely known. There are over a dozen major tranquilizers that are used with some frequency, but the most common are Mellaril (thioridazine), Thorazine (chlorpromazine), and Haldol (haloperidol). In children, these drugs are administered to control hyperactivity, aggressivity, self injurious acts and stereotyped behavior and to facilitate in general management. Compared to children in regular classrooms, surveys show that major tranquilizers are used more frequently to control behavior disorders in mentally retarded and emotionally disturbed children in special education programs. These drugs are discussed in Chapters 4 and 5.

Minor tranquilizers are much more aptly named *sedative-antianxiety* agents because one of their primary uses is in the management of anxiety. The minor tranquilizers can be subdivided into three major groups of drugs that share similar

properties. One category is the *benzodiazepines* which includes Valium (diazepam), Librium (chlordiazepoxide), Clonopin (clonazepam), Serax (oxazepam), and Tranxene (clorazepate). All have anticonvulsant properties, but Valium (the most frequently used prescription drug in the world) and Clonopin are more commonly used with epileptic children. Valium is also the most frequently prescribed skeletal muscle relaxant for children with cerebral palsy. At relatively high doses, Valium has hypnotic properties and, therefore, may be administered to induce sleep.

Diphenylmethane derivatives, a second category of minor tranquilizers, include Atarax (hydroxyzine hydrochloride) and Vistaril (hydroxyzine pamoate). They are infrequently used to control hyperactivity (see Chapter 2), and, in younger children, they may be administered to induce sleep. A third category, *propanediols*, includes Equanil (meprobamate) and related drugs. Although they are frequently prescribed for anxiety in adults, surveys show they are not used very often with children. The benzodiazepines are preferred over the propanediols for the treatment of anxiety because the latter are more apt to be fatal in suicide attempts and accidental poisonings (Goodman & Gilman, 1975).

Among the antidepressant drugs, there are two major categories, one of which, the *tricyclics*, is relevant to this discussion. As previously stated, the name *antidepressant* is misleading when one considers the variety of disorders for which these drugs are used. In children, Tofranil is the most frequently prescribed tricyclic drug. It is used most often in the treatment of enuresis (see Chapter 5) and occasionally for hyperactivity (see Chapter 2). Elavil (amitriptyline) is another tricyclic that may be used for hyperactivity but is more commonly prescribed for the treatment of depression in adults. The other category of antidepressant drugs is the *monoamine oxidase inhibitors*, usually abbreviated MAO inhibitors. They are used primarily with adults, typically for the treatment of depression.

Sedative drugs are used to calm anxious people and hypnotics are prescribed to induce sleep. The separation of these two categories is somewhat artificial because higher doses of some sedative drugs (e.g., minor tranquilizers) have hypnotic effects. One large group of hypnotic drugs, the barbiturates, has anticonvulsant properties. In fact, phenobarbital, Mebaral (mephobarbital), and Gemonil (metharbital) are all used primarily to treat epilepsy in children (see Chapter 3). Examples of nonbarbiturate hypnotics are Noctec (chloral hydrate), Paral (paraldehyde), and Doriden (glutethimide).

MOVEMENT OF DRUGS IN THE BODY

In order for a drug to exert its characteristic effect, it must be absorbed into the body and transported to the tissues and organs in which it typically concentrates. For the effect to be terminated, the drug must be changed into an inactive substance or removed from the body. The movement of drugs into, through, and out of the body can be described in terms of four processes: *absorption* (movement into the blood), *distribution* (concentration in body compartments), *biotransformation* (breakdown of drugs into compounds that can be more readily removed), and *excretion* (movement out of the body).

Drugs can be administered either by mouth (orally) or by injection (parenterally). The latter method includes injecting the drug through three different routes: *intravenous* (into the bloodstream), *subcutaneous* (under the surface of the skin), and *intramuscular* (into muscle tissue). Intravenous injections can produce relatively immediate effects because the process of absorption in the gastrointestinal tract is bypassed. When injected into a muscle, drugs are absorbed into the bloodstream via the capillaries in the muscle tissue. The rate of absorption can be increased by adding a substance that dilates blood vessels, or decreased with an agent that constricts blood vessels. Occasionally, major tranquilizers are administered intramuscularly in a form that is not very soluble. This slows the rate of absorption which in turn prolongs the effects of a single injection for several days. Subcutaneous injections are not used very often in the treatment of childhood medical disorders.

Psychotropic and antiepileptic drugs are usually taken orally. This is the oldest and probably easiest route of drug administration (Ray, 1978). To be absorbed, drugs in tablet or capsule form must dissolve in the fluids of the stomach and intestine. Drug molecules then pass through the cells that line the wall of the digestive tract and into the capillaries of the veins that lead from the gut to the liver.

A number of factors influence the rate of absorption including the chemical characteristics of the drug, changes in the acidity of the stomach, other drugs present in the digestive tract, less than adequate supply of blood, and illnesses that

result in a more rapid passage of food through the gut. Natural and added chemicals in the food we eat may also slow down or speed up this process. For example, dairy products, which are rich in calcium, slow down the absorption of tetracycline, an antibiotic. Because it is difficult to predict exactly how any change in the stomach or intestine may affect absorption, it is best to avoid, when possible, anything that might interfere with this process. For this reason, drugs are generally administered at least 1 hour before or 2 hours after eating.

Once in the bloodstream, drug molecules are distributed throughout the body concentrating in various areas referred to as *compartments*. The characteristics of the drug determine the sites of distribution and the degree of concentration. Some agents are restricted primarily to the circulatory system. Others pass through the capillary membrane into the water that surrounds the tissues and cells (the extracellular fluid) or concentrate in the water inside the cells (intracellular fluid) of specific types of tissue.

The molecules of most drugs combine with large molecules in the blood (plasma protein). This process is referred to as *plasma protein binding*. Bound molecules, because of their size, are unable to pass out of the bloodstream, and, unlike unbound (free) drug molecules, do not have a pharmacological effect on the body. An equilibrium is established between bound and unbound molecules. As free molecules pass out of the blood, bound molecules are released so the ratio of bound to unbound molecules in the blood remains the same. Although the maximal effect of the drug is reduced by protein binding, it prolongs the effect of the drug by creating a reservoir of bound drug molecules that are released over time (Briant, 1978).

The movement of drug molecules from the bloodstream into the brain is made more difficult by the presence of a *blood-brain barrier*. This is not an anatomical structure per se but refers to the fact that the capillaries of the brain prevent certain classes of compounds from entering and affecting brain neurones. A closeknit layer of glial cells surrounds the brain capillaries creating an additional barrier for compounds that are not lipid soluble. Without such a barrier, many chemicals in the foods we eat could directly alter the function of the central nervous system. Examples of agents that do pass through the blood-brain barrier are psychotropic and antiepileptic drugs.

The liver is the primary organ responsible for the breakdown of drugs (biotransformation) into new compounds (metabolites). Substances *(microsonial enzymes)* within the cells of the liver bring about or increase the rate of the chemical reactions that transform drugs into metabolites. Generally, an active drug is metabolized into an inactive, more water soluble compound(s) that can be excreted through the kidney. If lipid soluble drugs (e.g., Valium) were not transformed into water soluble metabolites, they would be reabsorbed into the bloodstream by the kidney, and a single dose could, therefore, last indefinitely (Briant, 1978).

Not all drugs are metabolized into inactive substances within the body. Some are excreted unchanged while others are transformed from inert substances into active metabolites. An example of the latter is the antiepileptic drug Mysoline (primidone) which does not appear to be effective in the treatment of epilepsy in its initial form (Callaghan, Feely, Duggan, O'Callaghan, & Seldrup, 1977). However, drug metabolizing enzymes in the liver convert Mysoline into an active metabolite(s) which in turn controls seizures.

The rate of drug metabolism in the liver can be greatly affected by the presence of another drug or chemical. For example, many drugs are known to slow down the metabolism of Dilantin (phenytoin) (Kutt, 1972). This is one form of drug interaction. Genetic factors also play an important role in determining the speed at which compounds are transformed. When the same drug is administered to a number of different people, the rate of metabolism may vary greatly (Vessell & Page, 1968).

The kidney is the primary organ responsible for the removal of drugs and their metabolites from the body in the form of water soluble compounds. Other pathways of elimination are feces, perspiration, and the milk of nursing mothers.

The rate of excretion can be influenced by the pH of the urine. For example, basic drug molecules are excreted more rapidly when the urine is acidic, and vice versa. Therefore, the presence of another drug or chemical that changes the pH of the urine could alter the rate of excretion.

DOSAGE

Before a drug is marketed, a considerable amount of information is collected about the effects of different amounts of the drug on laboratory animals and people. From reports of accidental poison-

ings and suicide attempts, it is even possible to determine fatal human dosage levels. In adjusting dosage, the physician starts with a small amount of the medication—usually below the therapeutic range. Over time, the dose is gradually increased until the desired response is achieved. This process is referred to as *titration*. Recommended dosage limits, both minimum and maximum, guide the physician in this procedure. If unwanted or intolerable side effects emerge, the dose may have to be reduced or the drug may be stopped completely and gradually reintroduced.

Although we often do not consider this, people differ from one another internally as well as externally. Individual variability in the way we react to drugs may reflect differences in the biological systems that are responsible for absorption, distribution, biotransformation, and excretion or simply differences in body size. In order to adjust dosage to physical size and thereby limit some of the variability in drug response, a measured amount of medication is administered per unit of body weight in kilograms (kg). A kilogram equals approximately 2.2 pounds.

Medication is typically measured in milligrams (mg). One milligram is equivalent to approximately 1/28,000 of an ounce. The actual dosage in milligrams per kilogram of body weight (mg/kg) can be calculated as follows $DW = M$, where D = desired mg/kg dose, W = weight in kilograms, M = actual amount of medication in milligrams. For example, let us assume the physician decides to administer drug A at a dose of 0.3 mg/kg. A child weighing 88 pounds (40 kg) would then receive 12 mg of drug A ($DW = M$; $0.3 \times 40 = 12$). For any given M, one can determine the mg/kg dose by a simple algebraic manipulation. Thus, for a child who weighs 44 pounds (20 kg) and is receiving 12 mg of drug A each morning, the dose would be 0.6 mg/kg ($\frac{M}{W} = D$; $12/20 = 0.6$).

With some drugs, particularly the anticonvulsants, the amount of medication administered in milligrams has little relationship with the amount in the blood. For example, if a number of people with epilepsy are given the same dose of Dilantin, the actual level in the blood would vary greatly from patient to patient (Lascelles, Kocen, & Reynolds, 1970). Therefore, a more useful measure than mg/kg for dose would be one that indicated how much drug was in the blood. That measure is the amount of drug, in micrograms (mcg or μg) for example, per milliliter (ml) of blood. These are very small amounts. For example, there are 1,000 micrograms in 1 milligram.

Monitoring blood levels of antiepileptic drugs is an important procedure in the effective management of many children with epilepsy (Kutt, 1974). In contrast, psychotropic drug treatment for learning and behavior disorders is not typically monitored in this way. In fact, procedures for determining blood levels are not yet available for many of these agents. It is noteworthy that a reliable method for assessing blood levels of Ritalin in children has only recently been developed for research purposes (Hungund, Hanna, & Winsberg, 1978).

DRUG INTERACTIONS

It is not unusual for children to receive two or more different drugs during the same day. Some disorders may require more than one medicine to achieve a satisfactory therapeutic response. For example, surveys of epileptic children in special education programs report that approximately half of the students receive two or more anticonvulsant drugs per day (Gadow, 1976; 1977a). When more than one drug is used to treat the *same* disorder, this is often referred to as *polypharmacy*. Children may also have more than one disorder which requires long term drug treatment. Studies show that from 7 to 10% of the children on medication in special education programs receive drugs for both behavior and convulsive disorders (Gadow, 1976; 1977a).

Another situation for which a combination of drugs is used is the management of unwanted drug reactions. For example, if a medicine causes serious side effects but cannot be stopped for therapeutic reasons, the physician may prescribe an additional drug specifically to control the side effect. There are also tens of thousands of nonprescription products available to parents for the treatment of common childhood maladies such as colds, headaches, upset stomachs, and so forth. We do not always regard these products as "drugs." However, the concomitant administration of a prescription and a nonprescription medicine is a drug combination. In general, drug combinations are an important consideration in that the effects of one agent may be significantly altered by the presence of another. When this does occur, it is referred to as a *drug interaction*.

One way in which drugs interact is an alteration in the absorption, distribution, biotransformation, or excretion of one agent by another. Changes in the rate at which these processes occur can result in an increase or decrease in the blood level of the altered drug. For example, if drug A slows down the rate at which drug B is absorbed into the blood, it will take longer for drug B to reach an effective level. This could be very important if it is necessary to get a high level of drug B into the bloodstream to be really effective for medical treatment. The rate at which drugs are broken down by the liver can also be altered. As noted previously, many drugs inhibit Dilantin metabolism (Kutt, 1972). Because Dilantin is poorly soluble in water, drug molecules must be transformed into water soluble metabolites before they can be excreted by the kidney. Therefore, a drug that inhibits the metabolism of Dilantin produces an increase in the blood level of the latter. Because there are now more Dilantin molecules in general circulation, the effect is greater. This could result in either unwanted side effects, fewer seizures if attacks were not completely controlled when Dilantin was administered alone, or both.

Another type of drug interaction occurs when two drugs with similar effects are given in combination. For example, alcohol and barbiturates both produce central nervous system depression ranging from mild sedation to coma, depending upon the amount consumed. When they are both used during the same period of time, their effects are *additive* and the outcome may be fatal. The combination of the two substances is similar to a much larger amount of either one ingested alone.

TOLERANCE

When the same dose of medication no longer has a characteristic effect after repeated administrations, this is referred to as *tolerance*. At the present, the exact mechanisms underlying this alteration in response are not well understood. Tolerance is reported in some children receiving Ritalin or Tofranil for hyperactivity who no longer react to medication the same way as when treatment was first started. In the case of Ritalin, a modest increase in dose is usually sufficient to maintain the desired response (Sleator, von Neumann, & Sprague, 1974). Occasionally, some hyperactive children show a dramatic therapeutic improvement with stimulants but then develop a complete tolerance (Gross & Wilson, 1974). For such children, increasing the dose only helps for a short time, and medication must eventually be withdrawn. Fortunately, children also develop a tolerance for many side effects. For example, antiepileptic drugs such as Mysoline and phenobarbital almost always produce drowsiness when treatment first begins. However, after receiving medication for a couple of weeks, most children are not bothered by this reaction.

Because drugs often have many properties, children may develop a tolerance for only some of them. As noted in the previous example, although children typically develop a tolerance for the drowsiness produced by phenobarbital, the seizure controlling properties of the drug may not change. Adjustments are typically made in the dosage of antiepileptic drugs as the child grows to accommodate for changes in body size, but this is not the same thing as tolerance.

Tolerance to drug effects can be manifested in different ways (Ray, 1978). *Behavioral tolerance* develops when an individual learns how to counteract the behavioral effects of the drug. This may explain, in part, the ability of some alcoholics to diminish the effect of alcohol, or "to hold their liquor."

Repeated drug administrations may also increase the rate at which drugs move through the body. This is referred to as *drug disposition tolerance*. For example, the regular intake of some drugs actually stimulates the metabolic processes responsible for the breakdown of the drug. To achieve the same effect, the dose must be larger than the previous one. This may only increase the rate of biotransformation and the cycle is repeated. In one study of epileptic adults treated with Dilantin, 45% showed a drop in the blood level of the drug over several months of treatment (Reynolds, Chadwick, & Galbraith, 1976). In some cases, the level dropped so low that seizures recurred in patients who were previously seizure free. The situation was remedied by increasing the dose. It should be noted, however, that in the treatment of epilepsy, this does *not* typically end in a vicious cycle of dosage increments.

Psychodynamic tolerance develops when the cells of the nervous system actually adjust to the presence of the medication. In order to achieve the same reaction to the drug, the dosage must be increased to overcome the body's compensatory mechanisms. If a neurological adjustment is made to the larger dose, even more medication will be required and so forth. This type of

tolerance is encountered with the euphoric effect of opium and related drugs.

Another reaction associated with the repeated use of certain drugs is *physical dependence*. This occurs when an agent alters the physiological state of the body, and, to prevent the appearance of a *withdrawal syndrome*, the drug must continue to be administered. Physical dependence has been demonstrated with a number of drugs including opiates, barbiturates, alcohol, amphetamines, and nicotine (Jaffe, 1975). Because the symptoms that characterize the withdrawal syndrome are associated with the same area of the body that was initially altered by the drug, they are sometimes referred to as *rebound effects*. For example, the sudden cessation of an antiepileptic drug (e.g., phenobarbital) may precipitate a seizure. This can be avoided by simply lowering the dose of medication over an extended period of time before stopping treatment. A similar type of reaction is also observed in some hyperactive children receiving short acting stimulant medication. When a significant amount of the drug has been removed from the body, the child becomes more hyperactive than when he or she is off medication altogether. At this time, it is uncertain whether all the symptoms of a withdrawal reaction to opiates and central nervous system depressants should be considered rebound effects.

The difference between physical dependence and *drug addiction* is not often made clear. Drug addiction refers to a "behavioral pattern of compulsive drug use, characterized by overwhelming involvement with the use of a drug, the securing of its supply, and a high tendency to relapse after withdrawal" (Jaffe, 1975, p. 285). It is important to note that one can be physically dependent upon a drug and *not* be addicted, or be addicted and *not* be physically dependent.

Parents and teachers often worry whether children receiving psychotropic or antiepileptic drugs for behavior or convulsive disorders are addicted. They are not! Nor are they more apt to become drug abusers in later life. Followup studies of hyperactive children treated with medication show they are not remarkably different from their peers in illegal drug use patterns and may even abuse drugs to a lesser degree than nonhyperactive children (Beck, Langford, MacKay, & Sum, 1975; Gross & Wilson, 1974; Henker, 1979; Lauter, 1971; Safer & Allen, 1975; Weiss, Hechtman, Perlman, Hopkins, & Werner, in press).

SIDE EFFECTS

No drug is completely free of side effects. There are a number of terms used to denote side effects, including "untoward reactions," "toxic effects," and "adverse drug reactions." Some side effects are trivial while others seriously impair health. Adverse effects may go away after a period of time (self limiting) or they may persist. If the disorder being treated is severe, side effects that are not self limiting may have to be endured. Side effects may appear shortly after the onset of treatment or may go unrecognized for months or even years. The pervasiveness of side effects often alarms people, but one must realize that the body is an extremely complicated chemical system whose functions are highly interrelated and that the alteration of one process affects others as well. It is noteworthy that what is an adverse drug reaction for one person may be the desired treatment response for another patient with a different disorder.

Adverse drug reactions can be categorized into three groups (Zbinden, 1963). The first and generally least serious are *functional* side effects which represent a change in the function of an organ. Examples of functional side effects of the nervous system are headache, slurred speech, incoordination, and dizziness. Most functional side effects are *reversible* (i.e., cease or gradually go away) when medication is stopped. Changes in the *biochemical* reactions associated with various organs are a second category of side effects. Two examples are alterations in the balance of hormones and changes in blood coagulation. Biochemical side effects are also usually reversed upon stopping treatment. A third group, *structural* side effects, involves an actual change in the structure of an organ. Examples of these are liver damage and cataracts. Obviously, functional and biochemical effects may also be associated with organ damage. The following chapters in the primer discuss mostly functional side effects that are clearly visible to parents and teachers. Drugs that are known to cause biochemical and structural side effects must be carefully monitored.

ROLE OF THE SCHOOL IN DRUG TREATMENT

Just the fact that psychotropic and antiepileptic drugs have a powerful effect on behavior, and that these agents are used relatively often with

children (particularly those in special education programs), should make drug treatment of interest to teachers. However, combined with the realization that the teacher can play a primary role in the treatment of children receiving medication and that the exclusion of school input may limit the effectiveness of drug therapy, this, then, becomes a matter of considerable importance. The usefulness of school participation in drug treatment with children is most convincingly documented in the treatment of hyperactivity (Sprague & Gadow, 1976).

The drug regimen consists of three stages: diagnosis, dosage adjustment, and followup. There is a period prior to referral and diagnosis when caretakers cope with the child's behavior and attempt educational programing, and a period following the termination of drug treatment when other approaches are used to ameliorate learning and adjustment problems. The predrug and postdrug periods have generally been excluded from most scientific investigations although there is no shortage of discussion on this matter, particularly with regard to the events that lead to referral (Bosco & Robin, 1976).

A series of studies conducted at the Institute for Child Behavior and Development at the University of Illinois at Urbana-Champaign have demonstrated the importance of teacher participation in the treatment of hyperactive children with stimulant medication (Sprague & Sleator, 1973, 1975, 1976). By simply completing a brief behavioral rating scale, teachers can provide the physician with valuable diagnostic information. In fact, it is often difficult to make a diagnosis of hyperactivity from behavior exhibited in the physician's office (Sleator & von Neumann, 1974). If a child is diagnosed hyperactive and the doctor decides to administer a trial dose of medication, the teacher can help by evaluating the response to medication. The importance of teacher evaluations to the entire treatment program is forcefully conveyed in the following quote (Sleator & Sprague, 1978):

> Remarkable sensitivity to drug effects on the part of the teacher has been replicated regularly in our laboratory. No other clinical measure even approaches this sensitivity and, in fact, we have found parents, on the average (although some parents are very sensitive), unable to distinguish even between on-drug and placebo periods . . . . We recommend strongly that monitoring of drug effects must include reports from the teacher if the physician hopes to effectively treat school children with learning and/or behavior disorders. (p. 579)

Hyperactivity is a drug treated disorder for which the efficacy of school involvement has been clearly documented. However, the role of the school in other chronic childhood disorders that are treated with medication (e.g., epilepsy) has not been investigated as systematically for at least two reasons (Gadow, 1978a). First, the treatment of other disorders is more generally accepted as being the total responsibility of the medical profession. Even though there are important psychological aspects in all forms of illness (Engel, 1977), they are more apparent in the management of behavior disorders. Second, therapeutic regimens (e.g. behavior therapy) which may involve the school have been limited primarily to behavior disorders. The opportunities for teacher participation in medical treatment programs are many when we consider that:

1. Hyperactivity is only one disorder for which psychotropic and anticonvulsant drugs are prescribed.
2. Other types of drugs can influence school performance.
3. Teachers can perform important referral, diagnostic, and treatment monitoring functions in the management of medical disorders for which drugs are not typically administered.

Although most special education teachers agree they should have a meaningful role in drug treatment (Gadow, 1976), what really happens in school settings is far short of their expectations. After reviewing several studies about school involvement in drug treatment, Sprague and Gadow (1976) reported that: (a) there is very little direct communication between the doctor and the school, (b) teachers feel they should be notified about drug treatment and the effects of the medication used, and (c) the adequacy of current drug monitoring procedures is questionable.

Even though most teachers demonstrate a clear willingness to participate in the evaluation of the drug regimen (Gadow, 1976), they are poorly trained in the area of drug treatment, have little in depth knowledge about the effects of drugs, and much of what they do know comes from personal experience. A content analysis of the difficulties teachers encounter with children

receiving psychotropic and antiepileptic drugs revealed five major problem areas:

1. The need for information about drug treatment.
2. Improved communication between teacher, physician, and school.
3. Guidelines for the involvement of school personnel in the drug regimen.
4. Parent inconsistencies in administering medication.
5. Physician failure to adequately monitor drug treatment (Gadow, 1977b, 1978a).

There appears to be considerable disparity between what researchers and clinicians perceive as proper treatment procedures and typical practices in real world settings. Unfortunately, space limitations do not permit the in depth discussion this topic deserves. The reader who is interested in the role of the school in drug treatment, the administration of medication at school, and suggestions about how to resolve some of the problems teachers encounter are referred to the papers by Gadow (1977b, 1978a, 1978b) and Sprague & Gadow (1976, 1977).

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2/Hyperactivity

In recent years, no other childhood disorder has received as much attention, generated more controversy, or left educators and parents in more confusion than the condition known as *hyperactivity.* The vagueness of the term has resulted in an "epidemic" of cases, causes, and cures (Freeman, 1976). Accusations have been made that teachers and physicians conspire to enslave boisterous school children in chemical straight jackets. It has been claimed that instead of accommodating our social institutions to the needs of these children, we take the easy way out—pills. Physicians, under pressure from parents and teachers, have been accused of capriciously "doping kids up." Critics say that creating medical disorders out of socially unacceptable behavior is a most hideous form of social control.

The emotional anguish that often accompanies uncertainty about what is the right thing to do for our children is aggravated by a host of individuals proclaiming they have found the truth. Eisenberg (1964) observed that the *less* that is known about a particular aspect of drug treatment, the *stronger* the convictions about what is correct and about what should be done. Although differing views may provide a healthy competition in the search for effective techniques and explanations, it is often difficult for parents to even know where to begin.

The school is often in the middle of this controversy because it is: (a) frequently the source of medical referral, (b) intimately involved in fostering academic achievement, and (c) one of the most challenging settings for the hyperactive child. This chapter is a sincere attempt to present an unbiased discussion of what is, to many parents and teachers, an emotionally charged topic: drug treatment of hyperactive behavior in children.

DEFINITION OF TERMS

Several dozen labels have been used to describe what we commonly refer to as hyperactivity in children. To add to the confusion, overactivity or motor restlessness is associated with a number of different behavior disorders. Also, the group of children who are described as hyperactive is so varied in terms of symptoms that eventually it may be subdivided into different categories as our knowledge of the condition increases (Loney, Langhorne, & Paternite, 1978). Safer and Allen (1976) proposed the following definition:

> Hyperactivity is simply defined as a long term childhood pattern characterized by excessive restlessness and inattentiveness. It is a developmental disorder which begins in early to midchildhood (ages 2–6), and begins to fade during adolescence. . . . The only necessary feature . . . is developmental hyperactivity (which) . . . is best determined by history. It is a *persistent* pattern of *excessive* activity in situations requiring motor inhibition. Persistent means consistently, year after year. Excessive means extreme (i.e., the most restless 3–5%). (pp. 5–7)

One of the more important distinctions in this definition is the fact that hyperactivity just does not pop up as a reaction to emotional stress, tight underwear, or fluctuations in blood sugar levels (Walker, 1974). It is a developmental disorder with an early onset. As an infant, the hyperactive child may be fretful, colicy, and restless. Mothers who have more than one offspring may even comment that their hyperactive child was more restless than his or her siblings *in utero*. Hyperactivity is usually first manifested during the preschool years, kindergarten, or first grade and is particularly noticeable in settings that include peers (e.g., day care and public schools). Older children who develop conduct problems for the *first* time between third and fifth grade should not be confused with children labeled hyperactive in this discussion (Safer & Allen, 1976).

Some clinicians may take issue with Safer and Allen's definition of hyperactivity as being too broad. However, the problem lies not so much in the definition as in the ambiguities inherent in diagnosing the condition (Loney, in press). Their definition does include two of the most widely accepted criteria for a diagnosis of hyperactivity: severe motor restlessness and a consistent developmental pattern. The former can be determined with the use of a behavior rating scale. Children receiving scores above a certain level are considered to be in the hyperactivity range. A consistent developmental pattern can be established with school reports from both present and prior teachers and from the child's parents. Although behavioral ratings and developmental histories from both the home and the school are two of the most frequently cited pieces of diagnostic information in the medical literature, a variety of procedures and criteria are employed in real world situations. What is diagnosed as hyperactivity by one physician may be considered emotional disturbance or "spoiled child syndrome" by another.

Classroom situations that require sustained attention and sitting still typically differentiate the hyperactive child from his or her peers. However, in other school settings (e.g., playgrounds) the differences may not be apparent. While some children are considered hyperactive in the school, the home, and the physician's office, others are preceived as hyperactive only at home or only in school (Lambert, Sandoval, & Sassone, 1978). This situational variability combined with the subjective nature of judgments about what constitutes "excessive" motor restlessness creates opportunity for disagreement among parents, teachers, and physicians as to whether or not a child is hyperactive.

The use of the term *hyperactivity* as a diagnostic construct is currently undergoing change. This is due, in part, to the recognition that poor attending skills rather than exessive motor restlessness may be the major obstacle to success in school (Douglas, 1972). In keeping with this observation, the American Psychiatric Association is changing its label for these children from *Hyperkinetic Reaction of Childhood* to *Attention Deficit Disorder with (or without) Hyperactivity*.

Two medical terms that are often used synonymously with hyperactivity are *hyperkinetic syndrome* and *minimal brain dysfunction* (MBD). Safer and Allen (1976) made a distinction between MBD and hyperactivity in that not all MBD children are hyperactive, and not all hyperactive children have learning disabilities, an important feature of MBD. For educators, the distinction is also useful because the term *hyperactivity* focuses in on a behavioral characteristic of the disorder, whereas MBD denotes etiology (cause). MBD implies that a child has some form of minimal brain damage. Critics have argued that this is similar to having a "touch of pregnancy." *Hyperkinetic syndrome* implies a collection of symptoms that are often found in association with one another. This expression has limitations in that the symptoms associated with hyperactivity do not fall into a closely knit cluster (Safer & Allen, 1976).

The hyperactive child usually has a number of other problems along with excessive motor restlessness. Inattentiveness, one of the most common problems, is defined by teachers as not being able to stay on a task for any length of time or follow directions. Parents state that when younger the hyperactive child cannot sit and watch TV like other children, is difficult to read to, and does not pay attention to what they say. Hyperactive children are often impulsive. They raise their hands in class in response to a question without first determining if they know the answer. Impulsive children rush into activities without thinking, and when younger, appear unable to keep themselves from doing things they clearly know are wrong. Teachers and parents alike report the hyperactive child jumps from one activity to another in an erratic manner. Poor school performance is also frequently associated with hyperactivity. Not only do these children achieve less well than expected, but often they have per-

ceptual-cognitive disabilities that hinder the development of language skills.

Other common features associated with hyperactivity are conduct problems and immaturity. Behavior problems at school take the form of hitting other children, not following classroom rules, disturbing others, and noisiness. Parents complain that the child is unmanageable. Because many hyperactive children do not act their age, people think of them as being immature. Their best friends may be several years younger and their interests may seem childish. Emotionally, they are easily frustrated and have temper tantrums when other children have outgrown that stage.

Some of the consequences of school failure and behavior problems are peer difficulties and poor self image. Immaturity, restlessness, and learning problems all contribute to the child's undesirability as a friend. One study of adults diagnosed and treated for hyperactivity as children reported that most considered their childhood to be unhappy (Weiss, Hechtman, Perlman, Hopkins, & Wener, in press). As adults, they stated that family fights (usually concerning themselves), feeling different (inferior, dumb), and being criticized "made things worse" as a child.

At one time, it was believed that children simply "grew out" of hyperactivity during adolescence (Laufer, Denhoff, & Riverside, 1957). However, more recent studies have shown that many of the problems associated with the disorder persist into adolescence and even into adulthood. (Safer & Allen, 1975; Weiss, Minde, Werry, Douglas, & Nemeth, 1971; Wender, 1978). Although hyperactive children become less restless during their early teens, teachers still consider their activity patterns to be different from those of their classmates. For many, impulsivity and inattentiveness are still major problems. Even as high school seniors, teachers rate the performance of hyperactive students as inferior to that of their peers. (Weiss, Hechtman, & Perlman, 1978). As adults, they are more apt to see themselves as being inferior in social interactions and have lower self esteem. Although they are still restless and impulsive, the level of education and degree of job satisfaction and job status is not significantly different from that of normal adults. (Weiss, Hechtman, Perlman, Hopkins, & Wener, in press). As adults, they stated that family fights (usually concerning themselves), feeling different (inferior, dumb), and being criticized "made things worse" as a child.

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A frequently asked question is what causes hyperactivity? Although there are a number of presumed causes, few are based on rigorous scientific inquiry. After reviewing the literature, Freeman (1976) noted the following have been identified as causes of hyperactivity: anoxia, maturational lag, allergy, maternal smoking, genetic factors, temperament, eye problems, subclinical lead intoxication, starvation, fluorescent lights, and psychosocial factors. Although some of these (e.g., genetic factors) may certainly have merit (Cantwell, 1975), others are truly questionable from the standpoint of the research methodology employed in determining their causal role. For example, Ott (1976) argued that children can be made hyperactive by fluorescent lighting in the classroom. This was based on a study that lacked even the most fundamental procedures for ensuring an unbiased evaluation. Data were collected using time lapse photography techniques. Some of the footage appears in the film *Exploring the Spectrum*, which has been widely shown to professional groups interested in learning disabled children. Later, a research team at the State University of New York at Stony Brook designed a well controlled study to determine if Ott's claims had any basis in fact (O'Leary, Rosenbaum, & Hughes, 1978). They found that standard cool white fluorescent lighting did not have an adverse effect on children who scored

well within the hyperactivity range on a widely accepted behavior rating scale. Space limitations do not permit an analysis of the research concerning the other hypothesized causes of hyperactivity, but suffice to say that too little is known to provide any helpful information.

PREVALENCE OF HYPERACTIVITY AND DRUG TREATMENT

One of the most common reasons for psychiatric referral among children is hyperactivity. The actual prevalence figures of hyperactivity among elementary school children varies from study to study, but the generally agreed upon figure is between 5 and 10%. If learning disability and a preschool history of hyperactivity are required as part of the criteria, the figure is about 5% (Safer & Allen, 1976). This would mean that in a classroom of 30 students, an average of 1 to 2 pupils would be characterized as hyperactive. All studies report that hyperactivity is much more common in boys than girls.

Lambert, Sandoval, and Sassone (1978) found the prevalence of hyperactivity varied depending upon who was asked to make the evaluation: teachers, parents, or physicians. When the criterion for hyperactivity was agreement among all three, approximately 1 to 1 ½% of students in their sample of 5,000 elementary school children were considered hyperactive. However, the prevalence of hyperactivity was 5% when based on all children considered hyperactive by either teachers, parents, or physicians. Because the prevalence of hyperactivity is often based on teacher ratings, they asked a sample of teachers to evaluate all the children in their class on a behavioral rating scale. A cutoff point for hyperactivity was determined from the scores of children considered hyperactive by all three sources. Approximately 12 to 13% of the children were scored as being in the hyperactivity range.

Because hyperactivity is often associated with epilepsy, cerebral palsy, emotional disturbance, learning disabilities, brain damage, and mental retardation, the prevalence of this disorder in special education programs may be quite high. For example, among mentally retarded children (birth to 12 years of age) in residential, community, and home placements, the prevalence of hyperactivity ranges from 29 to 58% depending upon the degree of retardation and the placement setting (Eyman & Call, 1977). The more severe the level of retardation and the more restrictive the placement (residential facility being the most restrictive), the greater the prevalence of hyperactivity. At this point it is unknown what percentage of these hyperactive mentally retarded children would be considered hyperactive in the same sense as nonretarded children. Diagnostic problems aside, a large number of school children in regular and special education classrooms have problems similar to those described by Safer and Allen in their discussion of hyperactivity.

More children receive psychotropic drugs for hyperactivity than for any other disorder. The best available data about the extent of drug use for hyperactivity among elementary school children comes from Baltimore County, Maryland. Krager and Safer (1974) reported the prevalence of drug treatment in that area was 1.1% in 1971 and 1.7% in 1973. By 1975, the prevalence of drug use was 2.1% but had increased only slightly in 1977 indicating a leveling off at approximately 2% (Krager, Safer, & Earhardt, 1977). In 1977, Ritalin (methylphenidate), by far the most frequently prescribed drug for hyperactivity, was administered to 82% of the children on medication. Approximately 9% were receiving Dexedrine (dextroamphetamine), 6% Cylert (pemoline), and 3% nonstimulant drugs. Teachers frequently ask if older children receive medication. These investigators reported that 0.66% of the students in middle and junior high schools were on medication for hyperactivity, about one third the figure for elementary schools. Cylert was used more frequently with teenagers than with the elementary school population, presumably because physicians want a a longer lasting drug for the older children.

The use of medication in the treatment of hyperactivity is more extensive with children in special education programs than in regular classrooms. Gadow (1976) surveyed teachers in noncategorical early childhood special education programs in Illinois about drug use. These programs served children, aged 3 to 5 years, who had learning problems, developmental delays, and handicaps ranging from mild to severe. It was found that of the 2,559 children in these programs, 7.9% received medication for hyperactivity at some time during the school year. By far the most frequently prescribed drugs were stimulants (primarily Ritalin) which were administered to 71% of the hyperactive children. Krager, Safer, and Earhardt (1977) also reported a higher prevalence of drug use in special education pro-

grams. They found that 15.3% of the children in programs for the severely and profoundly mentally retarded, physically handicapped, and emotionally disturbed were on medication for hyperactivity.

The prevalence of drug use for behavior disorders in public school programs for the trainable mentally retarded (TMR) is *less* than for preschool special education (Gadow, 1978a). Approximately 6.7% of the children in the TMR programs received drugs for behavior disorders in 1977. The primary reason for medication was hyperactivity. As in the other studies, stimulants were the most frequently prescribed drugs. Psychotropic drug treatment of mentally retarded students is discussed in greater detail in Chapter 4.

It is clear from these surveys that medication is used in the treatment of hyperactivity with children ranging in age from the preschool level through adolescence. Based on national school enrollment figures for 1974, a colleague and I estimated that between 600,000 and 700,000 school children in kindergarten through 8th grade were on medication for hyperactivity (Sprague & Gadow, 1976). Although there are problems inherent in making national estimates from selected samples, it is certainly true that large numbers of children receive stimulant drugs for this disorder.

BEHAVORIAL EFFECTS OF STIMULANT DRUGS

Since stimulants are by far the most frequently prescribed agents for hyperactivity, they are the only group of drugs discussed in this chapter in any detail. The stimulants most commonly used are Ritalin, Dexedrine, and Cylert. Two other stimulants, Benzedrine (amphetamine) and Deaner (deanol), were also once administered for hyperactivity, but they are rarely used now.

Stimulant drugs have been administered to treat childhood behavior disorders for over 40 years. Bradley (1937) was the first to report their effects on children with neurological and behavior disorders in a residential school. He noted that about half of the children receiving Benzedrine showed a marked therapeutic improvement, and commented:

> To see a single daily dose of benzedrine produce a greater improvement in school performance than the combined efforts of a capable staff working in a most favorable setting would have been all but demoralizing to the teachers, had not the improvement been so gratifying from a practical viewpoint. (p. 582)

A decade later, epileptologists discovered that Dexedrine was effective in the treatment of certain types of seizures (Livingston, Kajdi, & Bridge, 1948), and Bradley (1950) reported on the use of Dexedrine in the management of childhood behavior disorders.

Ritalin has been used to treat hyperactivity since 1956 and is now the primary drug used to treat this disorder (Safer & Allen, 1976). In 1975, the Food and Drug Administration approved a long acting stimulant, Cylert, for use with hyperactive children. Cylert is now used as frequently as or more often than Dexedrine (Gadow, 1978a; Krager, Safer, & Earhardt, 1977). Considering how long these drugs have been on the market, literally millions of American children at one time or another have received stimulant drugs for either hyperactivity or seizure control, or to counteract drowsiness produced by some antiepileptic drugs (Krager & Safer, 1974; Livingston, Berman, & Pauli, 1973; Sprague & Gadow, 1976).

Scores of studies have been published about the effects of drug treatment on hyperactive children and thousands of articles have been written about the disorder in general (Winchell, 1975). Because a number of excellent reviews of stimulant drug therapy are also available (Barkley, 1976; Barkley & Cunningham, 1978; Cantwell & Carlson, 1978; Conners, 1971; Eisenberg & Conners, 1971; Ross & Ross, 1976; Safer & Allen, 1976; Sprague & Sleator, 1973, 1975; Sprague & Werry, 1974; Whalen & Henker, 1976), this discussion of the behavioral effects of stimulant drugs focuses on only some of the well controlled studies. Changes in behavior that are the result of medication can be divided into five areas: activity level, motor performance, learning and cognitive performance, conduct problems, and school achievement.

Activity Level

The effect of stimulants on activity level is not just a simple matter of slowing the child down. For example, there is no difference in the activity level of hyperactive children in a playroom whether they are on placebo (fake pill) or taking Ritalin (Ellis, Witt, Reynolds, & Sprague, 1974). However, these *same* children are perceived as being much less active by the classroom teacher (Sleator & von Neumann, 1974) and wiggle

measurably less in their seats when asked to perform a task that required concentration (Sprague & Sleator, 1973). Stimulant drugs seem to affect movement during tasks that require sitting still and paying attention. They help the child channel his or her activity to one event instead of flitting from one thing to another. However, the change appears to be more *qualitative* than quantitative.

Motor Performance

A number of researchers have explored how stimulants alter fine and gross motor coordination and performance on perceptual motor tasks. Knights and Hinton (1969) investigated the effect of Ritalin on motor steadiness. Children were asked to: (a) move a stylus through a maze without touching the sides, and (b) hold a stylus in the center of a hole without hitting the edge. On both tasks, medication improved fine motor performance (i.e., the children could hold the stylus longer without accidentally touching the sides of the cutout maze and circle). Ritalin also facilitates the acquisition of motor skills. For example, Wade (1976) asked children to balance on a tilted 3 by 3 foot board that rotated on a central shaft. On medication, hyperactive children performed much better than when on placebo. More important, medication enabled hyperactive children to act more like their nonhyperactive peers. That is, they actually learned how to balance better over time (trials). Wade argued that Ritalin helps the hyperactive child learn motor skills the same way it affects the performance of cognitive tasks.

Ritalin can have a pronounced effect on handwriting as is evidenced in spelling tests for a girl in fourth grade treated at the Institute for Child Behavior and Development (see Figure 2-1). For the test dated January 20, this child was on med-

On Ritalin **On Placebo**

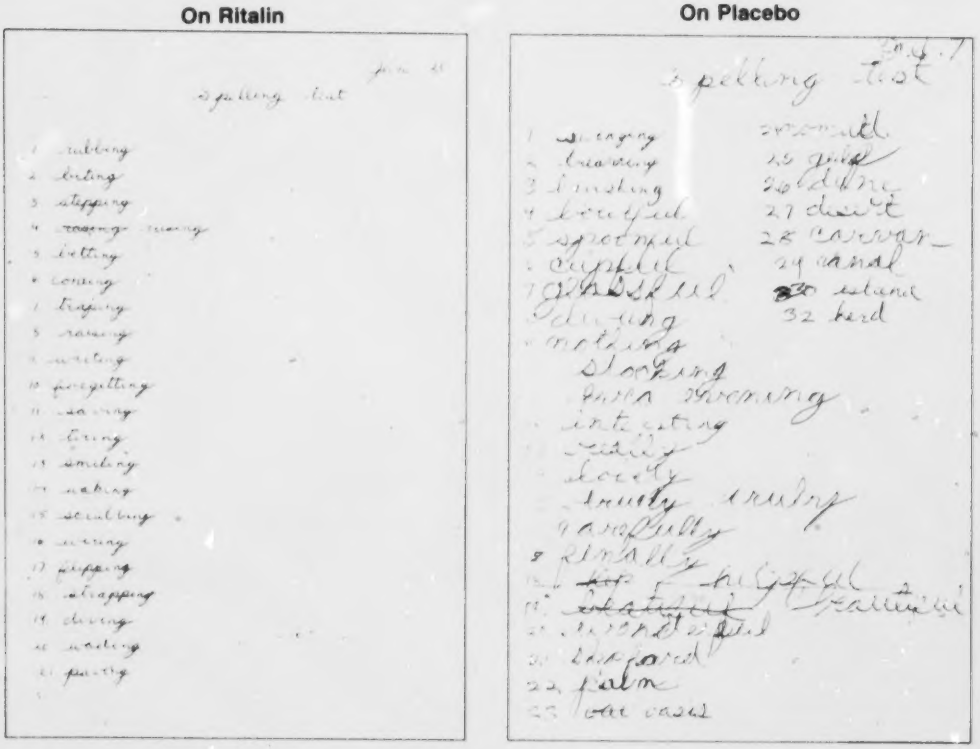

FIGURE 2–1

Handwriting sample of a child in 4th grade receiving long term drug therapy with an intermediate placebo period. (Courtesy of Dr. Esther Sleator, Institute for Child Behavior and Development, University of Illinois at Urbana-Champaign.)

ication. The handwriting is clear and legible. However, on placebo (February 7) writing skills rapidly deteriorated after the third word. Lerer, Lerer, and Artner (1977) compared the effects of placebo and Ritalin on the handwriting of 50 children diagnosed as MBD. All had serious problems with handwriting according to their teachers. Handwriting improved in 25 of the children on medication while improvement was reported for only one child on placebo. In general, handwriting deteriorated when children who showed improvement were taken off medication. However, gains in handwriting improvement were maintained for months in children who continued to receive Ritalin.

Cognitive Performance

Several different types of laboratory tasks repeatedly demonstrate improvement on some aspects of cognition with stimulant drugs. One of these, the Porteus Maze Test, requires the child to trace his or her way through a maze on paper using a pencil (Conners, 1971). The child must plan ahead a route through a maze to a finish point. An impulsive child charges into the maze with his or her pencil, blundering into dead ends before reaching the goal. Stimulant drugs seem to help the child focus attention on the maze, and under medication perfomance appears more thoughtful and reflective. Another task that clearly demonstrates stimulant drug effects is the Continuous Performance Test (Conners & Rothschild, 1968). It requires sitting and watching a screen as stimuli (letters, numbers, etc.) flash by one at a time in rapid succession. One form of this test asks the child to press a lever each time *X* follows a certain letter (e.g., *AX*). The task soon becomes boring, and the hyperactive child seems to lose interest and begins to make errors. On stimulant medication, hyperactive children seem to pay better attention, thus making fewer errors. An important feature of this type of activity is that it is not self paced.

A third type of laboratory measure of cognitive performance is a short term memory task (Sprague & Sleator, 1975). For this activity, the child sits and faces what appears to be a television screen. An array of pictures from children's books are flashed on the screen. Each array contains either 3, 9, or 15 pictures. The length of time each array is presented depends upon the number of pictures, one second for each. If an array with 9 pictures flashes on the screen, the child has 9 seconds to watch and memorize. The screen then goes blank, and one picture flashes on, e.g., a fire engine. If the fire engine was in the previous array, the child presses the "Yes" lever, but presses "No" if it was not. A small green light flashes on if the child is correct, a red light for a mistake. A counter adds up the number of correct answers or points. The counter serves as an incentive because the points can be exchanged for items in the Toy Shop. Most children find this activity enjoyable and interesting. Stimulant drugs enable hyperactive children to do much better on this task.

One of the more fascinating aspects of this research employing the short term memory task is the dose response relationship. In other words, how well a child does in trying to remember the pictures depends on the dose of medication (Sprague & Sleator, 1975). Most hyperactive children perform their best when the dose of Ritalin is between .3 mg/kg and .5 mg/kg. If the dose is increased to anywhere from .7 mg/kg to 1.0 mg/kg, children actually do worse on the short term memory task. This simply indicates that most children fit into this optimum dosage range for learning, and if such a child receives too much medication, it may not help him or her learn. In some children, a high dose may even impair cognitive performance (Swanson, Kinsbourne, Roberts, & Zucker, 1978). At this point, it is important to note that the relationship between dosage level and improvements in behavior problems is another matter.

Conduct Problems

Suppression of behavior problems is a fourth way in which stimulant drugs alter the performance of hyperactive children. Behavioral rating scales are the usual means by which such changes are documented. A number of rating instruments have been developed, but by far the most widely used is the Conners' Teacher Rating Scale (Conners, 1969). An abbreviated version (10 items) of the original 39 item scale appears in Appendix B. The Abbreviated Teacher Rating Scale (ATRS) is easy to complete and takes only about 2 minutes. Each item is rated from 0 (never occurs) to 3 (occurs very often).

The ATRS has been completed for a number of nonhyperactive children in central Illinois, and norms have been established. Therefore, the ATRS can be used as a screening device in the diagnosis of hyperactivity in that area of the country (Sleator & von Neumann, 1974). Because only 2½% of elementary school children

would receive a score of 15 or above, the physician can use the ATRS score as an indication of school problems. However, this is only part of the diagostic process (Safer & Allen, 1976; Sleator & von Neumann, 1974).

Using the ATRS, teachers have repeatedly demonstrated that stimulant medication suppresses behavior problems in the classroom. Even when teachers are not told if the child is on placebo or medication, they are very accurate evaluators of even small changes in dosage. Figure 2–2 shows teacher ratings for hyperactive children on placebo and on different doses of Ritalin. Moving from left to right, they score children the worst on placebo and best on the higher dose (0.7 mg/kg). Because certain school situations present special challenges for hyperactive children, it is not unusual for teachers to see big improvements in behavior when parents observe little or no change.

When medication is effective in suppressing conduct problems, the impact on the child and family may be considerable. In clinical settings, it is not unusual to hear parents rejoice after receiving the first favorable report from school (Sleator, 1978). I can recall a father explaining how drug therapy had changed his son's ability to participate in Little League baseball. Prior to treatment, the child was unable to follow the rules, wait his turn at bat, or play cooperatively with the other children. Reductions in the amount of conflict at home with siblings and neighbors as well as between parents over their child's problems are also reported. After conducting interviews with hundreds of parents of children on medication, it is clear that drug therapy may have a significant effect on behavior outside of the classroom (Gadow, 1977a, 1978c).

Although the short term effects of stimulants have been well documented, not all hyperactive

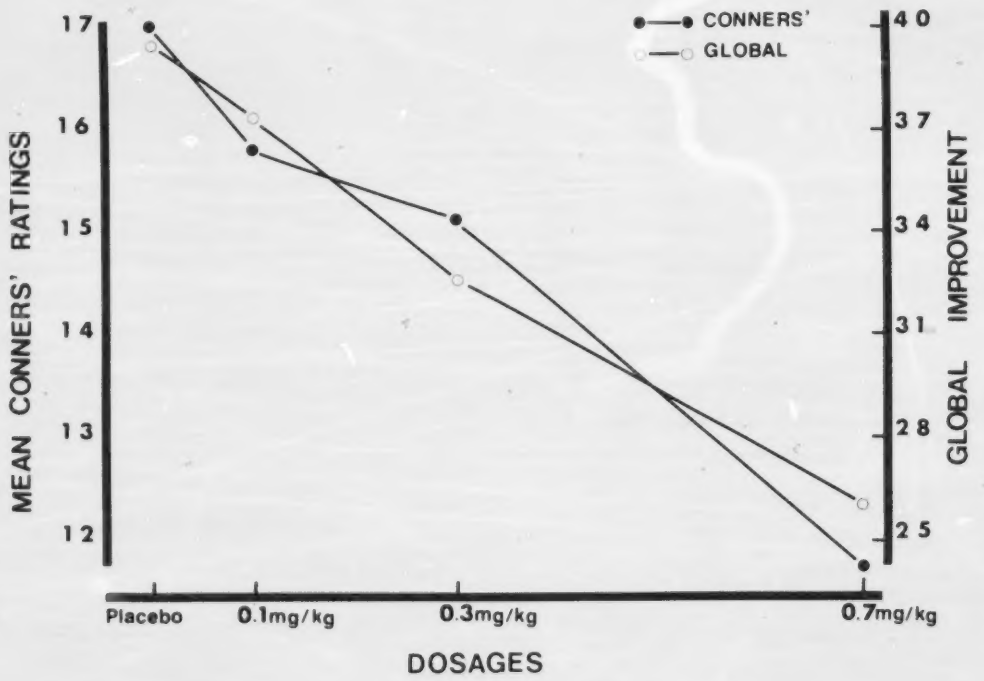

FIGURE 2–2

In both the global improvement scale and the mean Conner's ratings, the numerical value decreases with improvement in the child's performance. (From Sleator, E. K., & von Neumann, A. W. Methylphenidate in the treatment of hyperkinetic children. *Clinical Pediatrics*, 1974, *13*, 19–24. Copyright 1974 by J. B. Lippincott Company. Reprinted with permission.)

children are benefited by these drugs. Studies indicate that about one-fourth of the children treated do not respond favorably (Barkley, 1977). In such cases, the physician may try a variety of other agents or even combinations of drugs (Katz, Saraf, Gittelman-Klein, & Klein, 1975). Even so, 10 to 20% of the children diagnosed as hyperactive will be untreatable, at least in terms of conventional dosages and acceptable side effects.

School Achievement

If stimulant medication produces such positive changes in activity level, motor performance, social behavior, and cognitive performance, what does it do for school achievement? Unfortunately the evidence that children actually do better in school subjects is difficult to document. Although grades sometimes improve, this may simply be a reflection of the fact the child is less of a problem for the teacher. One would guess that if stimulants improved attention, then children taking such medication would do better because they could focus in on instruction. However, after reviewing the literature, Barkley and Cunningham (1978) concluded that there was little support for the notion that stimulant drugs improved academic performance.

Many hyperactive children lag behind their peers in school before drug treatment is started. As a result, any drug induced improvements in attention may have little consequence considering the obstacles to achievement. Medication may improve attention, but it is unrealistic to think stimulants also help hyperactive children catch up to their peers. To repeat a point made earlier, drugs do not teach the child anything. It is quite possible that without remedial instruction medication may not facilitate school achievement.

The effect of Ritalin on school achievement in learning disabled children was investigated by Gittelman-Klein & Klein (1976). Children were randomly assigned to either a placebo or drug condition. *Learning disability* was defined as "being 2 years below reading grade level despite average intelligence." None of the children were hyperactive or exhibited behavior problems in school. Although Ritalin improved performance on a number of psychological tests of cognitive ability, there was no significant change in academic achievement after 12 weeks of treatment. The authors concluded that "unless vocabulary, information, comprehension, and expressive skills are improved in children with learning disabilities, little hope of classroom change can be anticipated" (p. 663).

In order to determine if medication in combination with special instruction would help learning disabled children, an additional study was conducted by Gittelman-Klein (1978). Children with reading deficits were divided into three groups: (a) Ritalin plus reading remediation, (b) placebo plus reading remediation, and (c) placebo plus tutoring in subjects other than reading. The latter was a control to assess the effect of the remedial reading program. The results showed there was no significant difference between the first and second groups on measures of reading achievement (i.e., Ritalin did not improve the child's ability to learn how to read). The first group did better than the third group, but this was anticipated in that a specialized reading program was expected to be better than just tutoring.

Although these studies answer questions about stimulant drug treatment for learning disabled children, it is not known whether stimulants can help hyperactive children learn to read by making them more responsive to instruction. One of the problems in testing this hypothesis is that placing a severely hyperactive child on placebo for a few weeks, let alone months, is often unacceptable to both the family and the school. Nevertheless, the short term effects are so striking that many clinicians and researchers do feel that stimulants help hyperactive children learn, and that, if they are combined with specialized instruction, stimulant drugs can facilitate more normal development.

There appears to be some support for this notion that stimulants can facilitate learning. Sprague and Berger (in press) recently reported a comparison between the effects of placebo and Ritalin on different forms of an arithmetic achievement test in a 9 year old boy diagnosed as hyperactive. The test was programed on a computer assisted instruction system. On medication, the child gave a significantly greater number of correct answers to arithmetic problems than on placebo. Others have also reported improvements in arithmetic performance with hyperactive children on stimulant medication (Bradley & Bowen, 1940; Christensen, 1975). Although these data are suggestive, much research has yet to be done before the therapeutic

role of stimulant drugs in achievement on school related tasks is determined (Cantwell & Carlson. 1978).

Clinicians have often stated that stimulants have a "paradoxical" calming effect on hyperactive children (Millichap, 1975). Because no one had ever studied the effects of stimulants in normal children, it was unknown whether or not the decreased motor restlessness observed in hyperactive children receiving these drugs was truly "paradoxical." However, this question was recently resolved when a research team at the National Institute of Mental Health administered both Dexedrine and placebo to 14 normal prepubertal boys (Rapoport, Buchsbaum, Zahn, Weingartner, Ludlow, & Mikkelsen, 1978). The results showed that these nonhyperactive children responded to stimulants in much the same way as do children diagnosed as hyperactive. On a dose of 0.5 mg/kg, nonhyperactive children were significantly less active than when on placebo. They also had fewer errors on a continuous performance task (CPT) and they were able to learn and remember more words on a short term memory task. In addition, language performance was measured through picture descriptions, storytelling, and instructions to a listener. The drug seemed to help the child focus attention on these activities, as evidenced by increased task related speech and decreased nontask related speech. These results with nonhyperactive students are clearly contrary to the idea of a paradoxical effect of stimulant drugs for hyperactive children. Some might infer that stimulants are unwarranted as a treatment because they do not affect hyperactive children in some special way. However this situation is not unusual in medicine. For example, Rapoport et al. pointed out that diuretics are used in the treatment of congestive heart failure even though these drugs alter the bodily functions of normal adults and cardiac patients in the same manner.

The data from these studies clearly indicate that stimulant drugs diminish what Douglas (1972) referred to as an inability to "stop, look, and listen." In fact, the evidence is so compelling that Gittelman-Klein, Klein, Abikoff, Katz, Gloisten, & Kates (1976) commented:

> No rational, knowledgeable individual can dispute the efficacy of short-term stimulant treatment in the management of hyperkinetic children. Of all the therapies in child psychiatry, it is the best documented. (p. 362)

Long Term Therapeutic Outcome

Because these drugs do effect striking behavioral changes in hyperactive children, it would be reasonable to conclude that treated children would do better years later than untreated children. If stimulants enhance the ability to pay attention, a child who followed rules better, got into mischief less often, and generally acted more "normal" would be expected to be better adjusted. Therefore, with treatment, one would expect a hyperactive child to have more friends, get better grades, and be more popular than those who are not treated.

Barkley (1976) reviewed six followup studies of hyperactive children who received medication. Two of these studies included a group that did not receive drug therapy (Riddle & Rapoport, 1976; Weiss, Kruger, Danielson & Elman, 1975). In general, the findings from these studies indicated that hyperactive children on medication are still different from their nonhyperactive classmates. That is, stimulant drugs do not "cure" all the behavioral concomitants of hyperactivity. However, many clinicians who treat these children state they have had some cases who were literally made "normal" with drug treatment. One should not infer that, over time, the effects of medication simply wear off. Even after several years of treatment, withdrawal of drug leads to rapid behavioral deterioration (Sleator, von Neumann, & Sprague, 1974). Although medication continues to suppress deviant behavior, there is little change in peer relations or school achievement. What is even more discouraging is the fact that there is some evidence that treated children are not significantly better off in the long run than hyperactive children who do not receive drugs.

It must be emphasized, however, that these results are only suggestive. Not only do most of the followup studies suffer from serious methodological problems, but some children may respond to treatment more favorably than others. Unfortunately, attempts to find variables that would predict a favorable response to treatment before therapy is begun have not been very successful (Barkley, 1976; Loney, Prinz, Mishalow, & Joad, in press). Interestingly, there is some support for the notion that the nature and degree of hyperactivity symptoms at referral are generally *unrelated* to behavior at adolescence (Loney, Kramer, & Milich, 1979). In other words, whether or not a hyperactive child will have severe problems during adolescence cannot be

predicted from the severity of his or her restlessness, inattentiveness, or impulsivity when treatment first begins. However, hyperactive adolescents who do have serious problems tend to be more aggressive, come from poorer homes, and have less controlling fathers when they were first referred for treatment. If these environmental variables do play an important role in therapeutic outcome, this may explain, in part, why it is difficult to document long term benefits from medication. Much more will be known about the fate of hyperactive children and the effects of stimulants on therapeutic outcome when the followup studies presently being conducted at the University of Illinois, University of Iowa, McGill University, and other centers are completed.

Perhaps one of the more thoughtful conclusions that can be drawn at this time is that caretakers should not become sanguine about the needs of the hyperactive child just because medication is suppressing behavior problems. Special efforts must be made to ameliorate learning problems and developmental delays and to facilitate the acquisition of social skills. In their followup study, Weiss et al. (in press) asked their hyperactive subjects " 'what had helped them most during their childhood.' The commonest responses were: one parent (nearly always the mother) who believed in their final success; a teacher who seemed to turn the tide of failure; or discovering that they had some special talent." They go on to suggest that treatment programs for hyperactive children should have two goals: (a) "to help the child (by means of the various therapies available) to adjust better to his home and school environment" and (b) "to explore how the school can accommodate to [his or her] needs."

SIDE EFFECTS OF STIMULANT DRUGS

At moderate doses, stimulant drugs produce few serious side effects and are generally considered to be quite safe. At the onset of drug treatment, the two most common side effects are insomnia and anorexia (loss of appetite). Insomnia is typically not a problem if medication is administered only in the morning. However, many children receive a dose at noon and some even get medication late in the day. If such a schedule is necessary, the physician may prescribe an additional drug in the evening (e.g., Benadryl) to induce sleep (Arnold, 1973). Anorexia can usually be managed by taking the pill just before meals. Other minor side effects are also possible. These include headache, stomach ache, nausea, moodiness, irritability, and increased talkativeness. Children typically develop a tolerance for these side effects, but the dose may have to be reduced and gradually increased to lessen the degree of discomfort. Such possible side effects as hallucinations and dyskinesia (impaired or abnormal motion of voluntary or involuntary muscle) are very rare (Lucas & Weiss, 1971; Mattson & Calverley, 1968).

Perhaps the most distressing side effects for parents and teachers are changes in appearance and mood, and suppression of adaptive behavior. Change in appearance has been described as an "amphetamine look" by Laufer, Denhoff, & Riverside (1957):

> A pale, pinched, serious facial expression with dark hollows under the eyes. It is of no serious consequence but the parents must be prepared for adverse comment concerning the child's appearance. (p. 471)

They also report a marked decrease in activity:

> Sometimes, if too high a dosage (of Dexedrine) is given, the counteraction of the syndrome may go to the extreme of "freezing the patient" or fixating him to what he is doing, and may even put him to sleep. (p. 470)

Changes in activity level are not always appreciated if it is to an extreme degree. Parents sometimes comment that their child is "overly quiet," "stares into space," or "has a stillness about him that I don't like" (Gadow, 1977b, p. 35). These extreme changes in activity level and mood prompt teachers and parents to describe some children treated with stimulants as looking like "zombies" (Gadow, 1977b; Sprague & Gadow, 1976). Interestingly, Rapoport et al. (1978) found in their study of normal boys that Dexedrine made them appear "unusually inactive, not simply less restless" (p. 562).

Changes in mood may give the appearance of depression. Schain and Reynard, (1975) reported that 6.4% of the 6 to 12 year old children in his study became withdrawn, lethargic, and apathetic on Ritalin. The incidence of these reactions is evidently higher among preschool age children (Gadow, 1977a; Schleifer, Weiss, Cohen, Elman, Cvejic, & Kruger, 1975). All but three of the 28 children in the study by Schleifer et al.

(1975) were taken off Ritalin because of "less social behavior and interaction" or "sadness, irritability, excessive hugging and clinging, and increased solitary play" (p. 49). In his classic paper on hyperactivity in epileptic children, Ounsted (1955) described the "depression reaction" with Dexedrine as follows:

> One child aged 5 years 6 months . . . was given 2.5 mg of dextroamphetamine orally at 9:00 a.m. At 10:15 a.m. he sat down and became abruptly still. At 10:30 a.m. he began silently to weep and his usual rosiness was replaced by a grey pallor. He remained withdrawn, motionless, and weeping for four hours, and then reverted, over a period of two hours, to his habitual euphoria and energy. (p. 305)

Drowsiness, a side effect one would not ordinarily associate with stimulants, is sometimes reported by parents and teachers of young children (Gadow, 1977b). This effect of stimulants also appears in older children as well as in adults (Montagu & Swarbrick, 1975; Tecce & Cole, 1974).

The management of these reactions varies depending upon the clinician. Some feel treatment should be discontinued when medication produces pronounced mood changes or suppression of adaptive behavior (Schain & Reynard, 1975; Schleifer et al., 1975), while others see this as an indication to decrease dosage (Safer & Allen, 1976). Esther Sleator, research pediatrican at the Institute for Child Behavior and Development, stated that she observed these reactions in hyperactive children primarily on higher dosages of Ritalin (greater than .7 mg/kg). She also noted that reducing the dosage not only eliminates this side effect in most children but produces a more desirable therapeutic response from the standpoint of cognitive performance (Sleator, 1978).

Stimulant drugs also have an effect on the cardiovascular system. Ritalin, for example, has been shown to increase both blood pressure and heart rate (Ballard, Boileau, Sleator, Massey, & Sprague, 1976). Unlike most other unwanted reactions associated with stimulants, children do not appear to develop a tolerance for these drug induced changes. Although there is considerable variability across children in terms of the degree of change in heart rate and blood pressure, the higher the dose of Ritalin the greater the effect. At lower dosages (.3 to .5 mg/kg), these side effects are usually negligible. Researchers are uncertain at this point about the long term consequences of these changes in cardiovascular function.

Parents are often concerned about the long term effects of stimulant drug use. Although the benign, short term side effects of Ritalin and Dexedrine are well documented, only a few studies have investigated long term adverse drug reactions. There are a number of problems inherent in conducting well controlled followup studies, problems not peculiar to the investigation of stimulants and hyperactive children. For example, little is known about the long term consequences of toxic blood levels of antiepileptic drugs (Reynolds, 1975). This is interesting because Dilantin (phenytoin), one of the most frequently prescribed anticonvulsants, was first reported in the treatment of epilepsy only 1 year after stimulants were discovered to have a therapeutic effect on children with behavior disorders (Bradley, 1937; Merritt & Putnam, 1938). The only long term side effects of Ritalin or Dexedrine that have been reported so far are small changes in height and weight gain (Safer & Allen, 1973a). That is, children who receive Dexedrine or fairly high doses of Ritalin gain less height and weight than expected if not placed on medication. However, when drug treatment is stopped, children show a *growth rebound*, an increase in growth rate that compensates for the slower rate while on medication (Safer, Allen, & Barr, 1975). On the other hand, well controlled studies of hyperactive children receiving low and moderate doses of Ritalin have failed to demonstrate growth suppression (McNutt, Boileau, Cohen, Sprague, & von Neumann, 1977).

The Pediatric Advisory Panel of the Food and Drug Administration recently reviewed all the available literature about stimulants and growth suppression (Roche, Lipman, Overall, & Hung, in press). It was concluded that "stimulant drugs, particularly in the 'high normal' dose range, moderately suppress growth in weight . . . but early growth suppression during teatment is no longer evident in adulthood." The evidence for any suppressed growth in height is inconclusive. Because there may be some children who are affected to a greater degree than others, treatment should be carefully monitored and drug free periods (summer vacation, holidays) should be scheduled when possible.

REBOUND EFFECT OF STIMULANT DRUGS

For parents, a most frustrating reaction to stimulant treatment is the rebound effect, which is reportedly not uncommon. This occurs when the therapeutic benefits of the drug wear off usually in the late afternoon or early evening. This may also be a problem when drug free periods are scheduled on weekends. Presumably, the level of the drug in the blood drops, and the rebound is a drug withdrawal reaction. When the medication wears off, the child may be irritable and even more hyperactive than usual. In their study of the effects of Dexedrine on normal (nonhyperactive) boys, Rapoport et al. (1978), found that 10 out of the 14 children demonstrated "behavioral overactivity" approximately 5 hours after taking medication. Other signs of a rebound effect were "excitability, talkativeness, and for three children apparent euphoria" (p. 562). Although there are reports in the literature describing this phenomenon in hyperactive children (Katz et al., 1975; Werry & Sprague, 1974), the problems this may cause the family are not always emphasized.

PATTERN OF TREATMENT

Information from both the medical literature and various surveys indicate that stimulant drugs are prescribed for people of all ages who are diagnosed as hyperactive (or MBD). There are several reports of the use of stimulants with infants and toddlers (Nichamin, 1972; Renshaw, 1974), and the author has conducted a few interviews with parents of hyperactive children who began drug treatment between 12 and 24 months of age (Gadow, 1977a). Two well controlled studies have investigated the use of Ritalin with preschoolers (Conners, 1975; Schliefer et al., 1975), but most research involves children between the ages of 6 and 12 years. Safer and Allen (1975) reported that stimulants had therapeutic value for hyperactive adolescents, and others have found these agents to be useful in the treatment of adults with MBD (Mann & Greenspan, 1976; Wender, 1978).

Stimulants are relatively short acting drugs. Their behavioral effects can be observed within a half hour after taking the medicine orally. A 10 mg tablet of Ritalin produces a therapeutic effect for approximately 3 to 4 hours, and a 20 mg tablet lasts for at least an hour longer (Safer & Allen, 1976). There is a time release form of dextroamphetamine (Dexedrine Spansule) that produces a longer lasting effect than the tablets. Children on Ritalin show their best performance on learning tasks approximately 2 hours after taking medication (Swanson et al., 1978). Four hours after ingestion of the drug, it has already lost half of its peak effectiveness.

Using behavioral ratings, some researchers have demonstrated that one dose of medication in the morning is adequate for an entire school day (Safer & Allen, 1973b; Sleator & von Neumann, 1974; Sprague, Christensen, & Werry, 1974). However, almost all hyperactive children treated with Ritalin or Dexedrine are given a dose in the morning, and between 60 and 70% receive an additional dose at noon (Gadow, 1977a, 1978b; Krager & Safer, 1974). Stimulants are also given late in the day. One survey of hyperactive preschoolers reported that 28% of the treated children received Ritalin or Dexedrine in the evening (Gadow, 1977a). The parents of these children said medication helped their child go to sleep at night. Cylert, which is a long acting stimulant, is administered once each day in the morning. The starting dose is usually 37.5 mg which may be increased to 75 mg per day (Safer & Allen, 1975).

It is common clinical lore that Dexedrine is twice as potent as Ritalin and, therefore, the average dose of Dexedrine is half that for Ritalin (Safer & Allen, 1976). However, comparisons between the two drugs on laboratory learning tasks show they are fairly equal in effect (Sprague & Sleator, 1976). In actual practice, the daily dosages of Ritalin and Dexedrine prescribed by physicians are similar (Gadow, 1977a; 1978c).

There is some disagreement as to what is the best dose or dosage range for Ritalin and Dexedrine. Some clinicians have found that moderate dosages (.3 mg/kg- .5 mg/kg) of Ritalin are quite effective, while other experts feel that low dosages account for many of the cases of drug failure (Sprague & Sleator, 1975). Children do differ greatly in terms of optimal dosage. Some do quite well on a low dose while others appear unchanged unless the dose is very high. For this reason, most studies on the use of medication with children start out with a small dose that is gradually increased until the desired effect is achieved. There are obviously general guidelines for maximal and minimal limits. The average daily dose of Ritalin is usually 20 to 30 mg with a morning dose of 10 to 20 mg and a noon dose of 10 mg (Safer & Allen, 1976). It is *not* unusual, however, to find reports that state that

the average daily dose of Ritalin is 60 mg or that some children are receiving as much as 120 to 140 mg per day (Gittelman-Klein & Klein, 1976; Renshaw, 1974).

Approximately 10% of the children on medication for hyperactivity in special education programs receive two or more different drugs per day (Gadow, 1977a; 1978c). The additional drug is usually administered in the evening to induce sleep and may be a minor tranquilizer (Atarax, Vistaril, or Valium), Benadryl, or a hypnotic. Some children, however, are treated with a combination of: (a) Ritalin and Mellaril (thioridazine), (b) Ritalin and Tofranil (imipramine), and (c) Tofranil and Mellaril (Gittelman-Klein, Klein, Katz, Saraf, Pollack, 1976; Katz et al., 1975). However, these combinations are used infrequently in every day practice (Gadow, 1977a; 1978a).

In an important series of studies conducted at the University of Illinois, Sprague and Sleator (1977) demonstrated that the optimal dose for improving attention on laboratory tasks is different than the optimal dose for suppressing behavior problems. The relationship between dose of Ritalin and attention, classroom behavior, and heart rate is presented in Figure 2–3. Learning (solid black line) refers to the child's performance (percent of correct answers) on the short term memory task which has already been described. It is noteworthy that of the three matrix sizes (3, 9, and 15 pictures), the greatest difference in accuracy when dose was changed occured for the group of 15 pictures. Obviously, the larger matrix requires the most concentration because the child has to remember a larger number of pictures. Most (65%) hyperactive children gave more correct answers with a .3 mg/kg dose compared to both placebo (10%) and a higher dose (25%), 1.0 mg/kg. It appears that if the dose is increased even more, Ritalin will significantly impair performance on the short term memory task. This same dose relationship also holds for latency of response (the amount of time that elapses before responding). In other words, hyperactive children take less time to answer and, therefore, appear less inattentive. Behavior problems, on the other hand, become less and less apparent as the amount of medication is increased (dotted line). Using the ATRS, teachers rated 72% of the hyperactive children as behaving their best on the highest dose. Only 28% received their best ATRS score on .3 mg/kg, and none of the children showed their greatest improvement in behavior on placebo. The optimal dose of Ritalin for classroom behavior is, therefore, clearly different than that for concentrating on a laboratory learning performance task. Although the dosage differences for these two variables are significant in and of themselves, side effects are also important. As illustrated, heart rate (dashed line) increases as the dose becomes larger. The point where teachers perceive the most improved classroom behavior is also associated with side effects.

The results of the Sprague and Sleator (1977) study imply that careful consideration should be given to dosage adjustment and to the selection of treatment objectives. If higher doses are required to control severe behavior problems, side effects should be carefully monitored. One may well wonder what dosages are typically used by physicians in every day practice. Although data are limited, it appears that physicians prescribe conservatively—employing low and moderate doses (Gadow, 1977a; 1978d; Sprague & Sleator, 1975).

The length of time a particular child is treated with medication depends upon a number of factors. Because stimulants can ameliorate the problems associated with hyperactivity at any age, it is possible that drug treatment could last for many years with some children. Gittelman-Klein, Klein, Katz, Saraf, & Pollack (1976) reported that 5% of the hyperactive children in their study no longer required medication after 3 months of treatment. Sleator, von Neumann, and Sprague (1974), in a followup study of 42 hyperactive children, reported that 26% no longer required medication after 2 years of treatment. Solomons (1973) reported on a followup study of 97 hyperactive children who were treated by family physicians. In that study, the average duration of treatment was 39 months for children still on medication and 27 months for those no longer receiving drug treatment. It is clear that while some children require drug therapy for relatively short periods, others are maintained on medication either continuously or intermittently for many years. Pediatricians who treat relatively large numbers of hyperactive children have commented that many of their patients are maintained on medication through high school and into college if necessary. Because there is no real way to tell if drug therapy is still necessary other than by a temporary break in treatment, drug free periods are an important aspect of followup care. Some clinicians have argued that by starting the child in school off medication, the

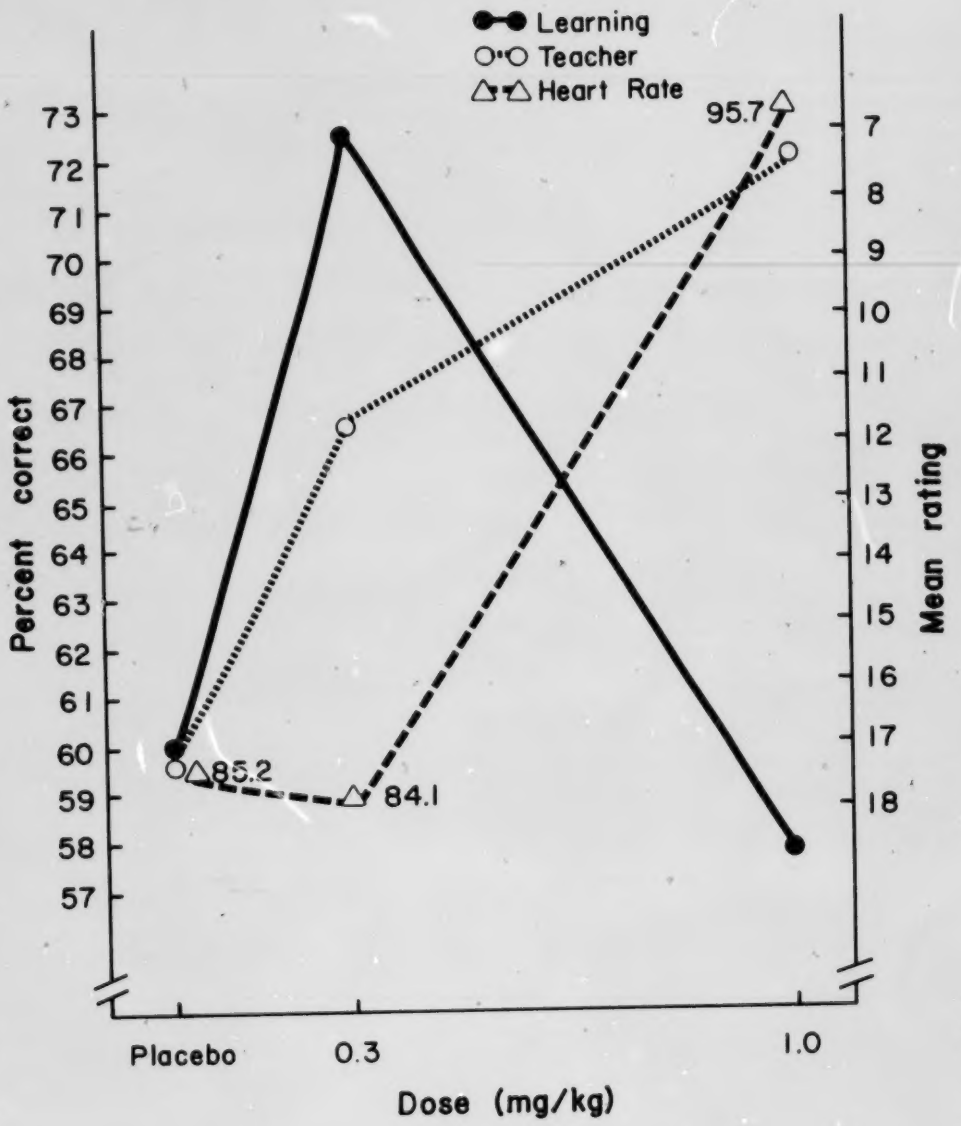

FIGURE 2-3

Three different target behaviors produced three different dose response curves. The learning curve represents accuracy on a short term memory task (matrix size = 15 pictures); the teacher curve represents social behavior as rated by the teacher, who used a scale on which the numbers become smaller as the child improves; and the heart rate curve (means placed on the data points) indicates the number of beats per minute. (From Sprague, R. L., & Sleator, E. K. Methylphenidate in hyperkinetic children: Differences in dose effects on learning and social behavior. *Science*, 1977, *198*, 1274–1276. Copyright 1977 by the American Association for the Advancement of Science. Reprinted with permission.)

continued need for treatment can be reassessed on a yearly basis (Arnold, 1973).

Although there is no shortage of discussion with regard to placing a child on medication or making diagnostic decisions, there has been little research about how to terminate treatment. O'Leary and Pelham (1978) conducted a study in which seven hyperactive children receiving stimulants were taken off medication and subsequently treated with behavior therapy. Before treatment was started, each child was placed on placebo for a short time to determine how bad his classroom behavior really was. When the study began, medication was either stopped immediately or terminated after gradual dosage reduction. For 4 months, the child's teacher and family were guided by a behavioral therapist while implementing behavior modification techniques. The main focus of the treatment program was the child's social behavior (conduct problems). The following month, both teacher and family carried out the program on their own. At the end of the fifth month, the children were reevaluated. The results showed dramatic improvement in social behavior to the point where the hyperactive children were not significantly different from their peers. The investigators noted that although the effects of their withdrawal and treatment program were encouraging, "behavior therapy is more expensive than drug treatment and should not be expected to benefit families who are not well motivated to attempt such an alternative to medication" (p. 216).

Very little information is available about how and why medication is terminated in real world settings. Two studies in which the parents of hyperactive children on medication were interviewed showed that therapeutic improvement was *not* the major reason for stopping drug therapy (Gadow, 1977a, 1978c). Parents often cite side effects, rebound effects, acquired tolerance for therapeutic response, and failure of the drug to work effectively as reasons for taking their child off medication. One of the major reasons why medication is stopped during adolescence is that teenagers often refuse to take pills because it sets them apart from their peers and contributes to feelings of being "different" (Safer & Allen, 1975; Sleator, 1978).

NONSTIMULANT DRUGS

As previously stated, not all hyperactive children respond favorably to stimulant drugs. In such cases, the physician may give an alternative agent for a trial period. A wide variety of nonstimulant drugs have been used, including major tranquilizers, antidepressants, minor tranquilizers, anticonvulsants, and others. Because major tranquilizers are discussed at length in Chapter 4 and anticonvulsants in Chapter 3, they will not be further covered here.

Tofranil (imipramine) is an antidepressant that has been used to treat hyperactive children (Rapoport, Quinn, Bradbard, Riddle & Brooks, 1974). The total daily dose ranges from 50 to 180 mg usually divided into three doses of 50 mg or 75 mg per day (Winsberg, Yepes, & Bialer, 1976). The major side effects are drowsiness, dizziness, dry mouth, nausea, increased appetite, and weight gain. Many children develop a tolerance to the therapeutic response (Quinn & Rapoport, 1975). Some serious side effects have been reported. For example, Tofranil may lower the seizure threshold, especially in brain damaged children (Brown, Winsberg, Bialer, & Press, 1973). Also one death has been reported in the case of a 6 year old girl who was administered 300 mg (14 mg/kg) of Tofranil in one dose before bed (Saraf, Klein, Gittelman-Klein & Groff, 1974). A major use of Tofranil with children is in the treatment of enuresis. This is discussed further in Chapter 5.

The antihistamine Benadryl is sometimes used with hyperactive children. Fish (1971) found the drug particularly effective with children who had severe behavior problems. It is also administered at bedtime to calm a child down (Arnold, 1973; Gadow, 1977a). The dose to induce sleep is 50 to 100 mg, and, for daytime use, 100 to 200 mg per day (Safer & Allen, 1976).

Two minor tranquilizers, Atarax and Vistaril, are used infrequently. Their effectiveness in the management of hyperactivity is questionable, but they may be used in the evening to induce sleep (Gadow, 1977a; Greenberg, Deem & McMahon, 1972).

OTHER TREATMENTS

A variety of other treatments have been proposed for the management of hyperactivity. These include the use of coffee (caffeine), megavitamins, a diet free of food additives, and behavior therapy.

Ross and Ross (1976) reviewed five studies in which coffee or caffeine was used as a treatment

of hyperactivity and found the results were inconclusive. While some researchers found therapeutic benefit, others showed that coffee was no better than placebo and certainly not as effective as stimulants in controlling hyperactive behavior. At this point, further research is necessary to determine if coffee suppresses behavior problems and enhances the ability to pay attention in hyperactive children.

Cott (1972) has argued that megavitamins should be used to treat hyperactive children. To date, there have been no well controlled studies that support this claim.

Perhaps the most hotly debated treatment for hyperactivity is the Kaiser-Permanente (K-P) diet, also called the Feingold diet (Feingold, 1974). The diet consists of eliminating foods that contain artificial food coloring (especially red and yellow dyes), BHT (butolated hydroxy tolulene)—a food preservative, and natural solicylates (in foods such as apricots, prunes, raspberries, tomatoes, and cucumbers). Although Feingold never conducted well controlled studies that documented the effectiveness of the diet, he claimed that 30 to 50% of the hyperactive children would show marked behavorial improvement on an additive free diet. Surveys show that between 20 and 35% of the hyperactive children who have been on medication were also placed on this diet (Gadow, 1978c; Lambert, Sandoval, & Sassone, 1978). In order to test this hypothesis scientifically, a research team at the University of Wisconsin conducted a study with 46 children diagnosed as hyperactive (Harley, Ray, Tomasi, Eichman, Matthews, Chun, Cleeland, & Traisman, 1978). These researchers purchased all the groceries for the participating families during the 8 week study as well as buying snacks for special activities at school (e.g., birthday parties, holidays). To control for any biases the family received the K-P diet for 4 weeks and the fake (placebo) diet for 4 weeks. In addition, the K-P diet was disguised by using specially prepared commercial foods that normally contained additives but were really additive free. After collecting numerous measures on behavior at home, school, and in the laboratory, the researchers did *not* find the K-P diet helped hyperactive elementary school children. Because another researcher has found that the K-P diet works for some children (Conners, Goyette, Southwick, Lees, & Andrulonis, 1976), the issue is still unresolved. If, for whatever reason, the K-P diet helps hyperactive children, it is so for a much smaller percentage of such cases than was originally claimed by Feingold.

Feingold has also stated that if a child who is placed on the K-P diet and responds well eats food containing artificial food colors and/or flavors, his or her hyperactivity will reappear within a few hours after the dietary infraction. Investigations into this hypothesis using children who respond favorably to the diet are inconclusive. While the results of some studies support this claim, others do not (Conners, 1978).

To date, there is only one report on the effectiveness of the K-P diet in comparison with another treatment (Williams, Cram, Tausig, & Webster, 1978). It was found that stimulant drugs were more effective in controlling the behavioral symptoms of hyperactivity than a diet free of artificial food colors and flavors.

People often ask, "What harm does it do to try a particular unproven treatment?" The primary problem with this point of view is that the use of a worthless method only denies the child a meaningful approach to his or her therapeutic needs. One might wonder, "What's wrong with at least giving it a try?" The problem here lies in the expectancy effect. If we want or expect something to happen, it is not unusual to perceive events as being the way we think they should be, or want them to be. Therefore, a useless approach may appear to be a "cure." If the remedy is associated with a strong placebo effect that benefits the child, one might ask, "What's wrong with that?" If there really is an improvement in the child's condition for whatever reason, so much the better. However, if problems persist, using the placebo is not a solution and its use may also serve to divert the therapist's attention away from more germane remedies.

Another approach to managing hyperactive children and one for which there is considerable support, clinical and research, is behavior modification (Ayllon, Layman, & Kandel, 1975; O'Leary, Pelham, Rosenbaum & Price, 1976). Because behavioral techniques can be used successfully with these children, many have argued that they should be tried *before* medication. In terms of educational programing, behavior modification is perceived by some as a "less restrictive" approach than drugs to the amelioration of learning problems. Research into the relative effectiveness of these two treatments is certainly called for. However, at this writing, only one study has been reported comparing the effi-

cacy of medication, in this case (Ritalin), and behavior modification (Gittelman-Klein, Klein, Abikoff, Katz, Gloisten, & Kates, 1976). In that study, severely hyperactive and disruptive children were assigned at random to one of three different groups: (a) combination of Ritalin and behavior modification, (b) Ritalin alone, and (c) combination of placebo and behavior modification. All three treatments significantly reduced behavior problems as measured on rating scales. However, the group receiving only Ritalin was rated as significantly more improved than the children in the behavior modification-placebo group. The children in the combined Ritalin-behavior modification group were rated just slightly better than those in the Ritalin only group.

While these results are interesting, they pertain to a specific group of children studied for an 8 week period. If the dose of Ritalin were lower, the children less hyperactive, or the behavior modification program less intense, the outcome may have been different. It is not known what the comparative long range effects of these different treatment approaches are for such studies have not been done. It is possible that a long term study may show that behavior modification is equal or superior to Ritalin. However, there are major problems with the long term implementation of rigorous behavior modification both in terms of research methodology and practical limitations in home and classroom settings (Mash & Terdal, 1977).

To restate a point discussed previously, long term studies have not been conducted comparing the effects of drug treatment and behavior modification (or specialized learning programs) on school achievement. However, a growing number of investigators are demonstrating that special training programs (Douglas, Parry, Marton, & Garson, 1976), classroom organization (Flynn & Rapoport, 1976) and modifications in teaching methods (Zentall, 1977) can either effect changes in the behavior of hyperactive children or create an environment more suitable to the child's style of learning. Much research has yet to be done in these areas. After effective techniques are developed, questions similar to those posed about drug therapy will remain: Do these new methods make a difference in long term outcome with hyperactive children? How effective are they in comparison to other therapeutic measures (including medication)? And, are the differences among children, families, schools, and physicians important in deciding which treatment approach is most appropriate? In recent years, hyperactivity has been one of the most heavily investigated topics in pediatric medicine, child psychology, and education. It is hoped that the products of these efforts and future research will provide insight into the care of these often unhappy children who frequently encounter frustration and failure in an environment poorly adapted to their needs.

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3/Convulsive Disorders

Most discussions of medical disorders prepared for nonmedical audiences are encumbered with the necessity to define terms, and the topic of convulsive disorders in children is no exception. The primary symptom of a convulsive disorder is a *seizure*. To an observer, a seizure is a sudden attack, usually manifested by a complete or partial loss of consciousness and accompanied by involuntary muscle movement or a cessation of body movement. If the seizure involves violent, involuntary contractions of skeletal muscles *(convulsion)*, it may be referred to as a *convulsive seizure*. A distinction is sometimes made between convulsive (grand mal) and nonconvulsive (petit mal) seizures. In this discussion, the terms seizure and convulsion are used interchangeably.

Seizures are caused by a sudden discharge of electrical energy in the brain. The actual reason for these discharges and the greater susceptibility to them for some people remains obscure. Anyone can have a seizure if the appropriate stimulus causes an electrical discharge in the brain. Such stimuli could be associated with certain types of infections, poisons and drugs, sudden oxygen deprivation, metabolic disturbances, and a number of other factors. Seizures are considered to represent a convulsive disorder only when they are recurring in nature. Recurring seizures are frequently referred to as *epilepsy*, and this is the preferred term for designating such seizures according to groups such as the Epilepsy Foundation of America and the National Epilepsy League. However, it has been my experience that many parents use terms such as *seizures, convulsions,* and *spells* when referring to their child's disorder. In addition, these terms seem to be more behaviorally oriented in that they focus on the visible features of the disorder, the reason for which drugs are prescribed, and the yardstick against which the effectiveness of medication is measured (i.e., seizure suppression).

Recurrent seizures are sometimes classified according to what is known about their cause. If the cause of the seizures is unknown, they are said to be *idiopathic*. In approximately one fourth to one half of all cases of epilepsy, the cause of the seizures is unknown. Idiopathic epilepsy is more common among children with seizures, especially those over 4 years old, than among adults. Seizures that develop as a result of permanent, nonprogressive changes or damage to the brain are called *secondary* or *organic* epilepsy. For example, convulsions that develop after a head injury sustained in an automobile accident would be secondary seizures. One should not infer that the head trauma is the sole cause of the disorder because not all children with equal degrees of head injury develop seizures. It is quite possible there is a complex interaction between an unknown factor(s) and the trauma that causes a convulsive disorder. This same unknown entity may also cause idiopathic epilepsy.

The actual sensory and motor phenomena associated with the seizure depend upon which cells in the brain are affected by the electrical

discharge. If only part of the brain is affected the resulting seizure is considered *focal*. Symptoms of the attack might be the twitching of a finger or arm, a strange sensation, or a change in mood. If the electrical activity affects the entire brain, the resulting seizures are said to be *generalized*. Examples of generalized seizures are grand mal, petit mal, and myoclonic. It should be noted that a seizure could originate as a focal seizure but progress into a generalized seizure. For example, a true *Jacksonian* seizure, rarely found in children, is a focal seizure that may begin by a twitching in a finger of the right hand, which progesses to jerking movements of the hand and right arm, then to twitching movements on the right side of the face continuing on down the same side of the body (Livingston, 1972). The jerking movements then spread to the other side of the body. During this part of the attack, the individual usually remains conscious. The seizure is focal in that specific motor areas of the brain are affected. The electrical discharge then spreads throughout the brain culminating in a generalized grand mal seizure during which the individual is unconscious.

Much of the discussion in this chapter is based on the clinical experience and research efforts of Dr. Samuel Livingston, Director, Samuel Livingston Epilepsy Diagnostic and Treatment Center, Baltimore, Maryland. Over the past 40 years, he has treated 38,000 epileptic patients, most of whom were children when seizures first began. His publications not only provide a broad data base, but also a consistent conceptualization of the field. Because of the number of inconsistencies in the literature about convulsive disorders and the variety of treatment techniques employed by physicians, Livington's position is used as a standard against which other opinions are measured (Livingston, 1972, 1978a, 1978b).

PREVALENCE OF CONVULSIVE DISORDERS

Due to a number of factors, there is considerable variability in the prevalence of epilepsy reported from study to study. Actual prevalence rates range from 1.5 to 20 cases per 1,000 with a median of 3.8 people with epilepsy for every 1,000 in the general population (Meighan, Queener, & Weilman, 1976). However, many epileptologists believe most prevalence studies underestimate the true extent of convulsive disorders. Livingston (1972), for example, feels that 1 in 50 Americans will have epilepsy at some time during their lives. Similarly, the Epilepsy Foundation of America (1975) has adopted a 2% prevalence rate for convulsive disorders in the general population.

One of the reasons many studies have underestimated the extent of this disorder is that untreated persons are frequently excluded from survey studies, and, of course, many cases go undiagnosed. Recently, efforts have been made to detect undiagnosed and untreated cases of epilepsy. Using a combination of diagnostic and survey techniques, Rose, Penry, Markush, Radloff, and Putnam (1973) reported a "reasonable" prevalence rate of 18.6 cases of epilepsy per 1,000 among third grade children.

Although dozens of studies have been conducted on the prevalence of epilepsy per se, there are few published statements about the prevalence of drug treatment for this disorder among school age children. Gadow (1976, 1978a) reported that at least 6.6% of the children in early childhood special education programs and 11.9% of the students in classrooms for the trainable mentally retarded receive medication for convulsive disorders at some time during the school year. Approximately 30% of the residents in facilities for the mentally retarded receive drugs for seizure control (O'Neill, Ladon, Harris, Riley, & Dreifuss, 1977; Payne, Johnson, & Abelson, 1969). Assuming the prevalence figures based on school children identified and treated for convulsive disorders are also a fairly accurate description of the extent of drug use, between 0.3 and 0.6% of the students in regular classrooms are on medication for epilepsy (Force, 1965). It is clear that a much greater proportion of children in special education programs receive antiepileptic drugs.

At least three-fourths of all the people with epilepsy experienced their first seizure before the age of 20 (Lennox, 1960). The highest incidence rates (number of new cases) are for infants from birth and 2 years, children between the ages of 5 and 7, and adolescents (the onset of puberty). The latter is particularly true for females who may experience seizures with their first menstruation (Livingston, 1972).

CLASSIFICATION OF CONVULSIVE DISORDERS

Most convulsive disorders can be categorized as belonging to one of several groups. However,

there are a number of different classification schemes, and often several different terms are used to denote the same seizure type. For lay people and professionals alike, this proliferation of terms creates both confusion and misunderstanding. This problem is not peculiar to the study of convulsive disorders, as one who has familiarity with the literature about learning disabilities and hyperactivity well knows. For many people, scientific jargon is both an inconvenience and an irritant. We often wonder if these name games are really necessary, and, if so, how meaningful they are. However, in the case of convulsive disorders, a convincing argument can be made for acquiring some basic information about the different types of epilepsy and for categorizing them accordingly.

Seizures differ in terms of their pattern, frequency, and duration as well as the age at which they usually begin. The prognosis and response to treatment varies depending upon the type of seizure, and, central to this discussion, the type of drug the physician selects has a lot to do with the kind of seizure the child is being treated for. Because basic information about a child's seizures can provide the teacher with some understanding of the treatment process, particularly medication, the topic of classification is discussed in some detail.

In the not too distant past, seizures were generally categorized as being either grand mal or petit mal. However, the development of more sophisticated diagnostic techniques, discovery of new antiepileptic drugs, and a more rigorous investigation of response to treatment prompted an appreciation for the various types of seizures. There are at least three different approaches to classification: electroencephalographic readings (EEG), presumed cause or origin of the electrical discharge in the brain, and the outward appearance of the seizures. Livingston (1972) proposed five major types of childhood epilepsy based on EEG findings and the overt appearance of the seizures: *major motor (grand mal), petit mal, psychomotor (temporal lobe), myoclonic* and *autonomic*. Each of these is described in the following sections in terms of the age at onset, frequency and duration of seizures, and EEG findings. These data are summarized in Table 3–1.

Major Motor (Grand Mal) Seizures

By far the most common type of seizure is major motor (grand mal). Approximately 80% of the children with convulsive disorders have grand mal seizures. The actual seizure consists of two phases: a *tonic* phase in which the body becomes very rigid, followed by a *clonic* phase that consists of jerking movements of the limbs (convulsions). Typically, there is a sudden loss of consciousness, the body stiffens (tonic phase), and, if standing, the child falls to the ground in the direction he or she is leaning. Breathing stops and the face may turn pale. This is followed by jerking movements of the body and limbs (clonic phase). The child's breathing makes a snoringlike sound. During the convulsive phase of the seizure, the child could bite his or her tongue or cheek, urinate, or defecate.

If the seizure is of short duration (3 to 5 minutes), the child is usually able to resume his or her regular activities shortly after the attack. If the seizure is long lasting (up to an hour or more), it may be followed by deep sleep. It is best to let the child sleep since attempts to awaken him or her will not be successful. Many children, after awakening from a post convulsive sleep, will exhibit any of a variety of different reactions to the seizure, including fatigue and sore muscles, nausea or headache, and behavioral changes such as irritability, restlessness, or even aggressivity. It does little good to scold or punish the child during this period. If the child's behavior is harmful to others, he or she may have to be isolated from his or her peers until this phase of the seizure passes. Postconvulsive reactions may last from a few minutes to even a day or longer. The frequency of major motor seizures varies greatly among children. Some have many convulsions per day while other children have only one seizure every few years.

It must be emphasized that what has been described here is a "typical" grand mal seizure. In reality, the actual behavioral changes may vary considerably. For example, the entire seizure may consist of only a tonic phase or only a clonic phase. Also, the child may simply go limp (atonic) dropping to the ground as if he or she had fainted without either a tonic or clonic phase. Unconsciousness may be complete or partial.

It is not unusual for a child with grand mal seizures to have a normal EEG reading. In one study of 3,101 patients with major motor seizures, a third had normal EEG patterns between seizures both while awake and during sleep (Livingston, 1958). There are, of course, gross changes in the EEG during the seizure as well as in the postconvulsive phase.

TABLE 3–1

Clinical and EEG features of classificational types of epilepsy observed in children*

Type of Epilepsy	Age at Onset	Seizure Pattern	Duration of Seizure	Frequency of Seizures	EEG Findings
Major Motor (grand mal)	May occur at any age	Generalized tonic-clonic tonic clonic atonic Focal	Variable: most commonly, several to 5 minutes or so; however, may last as long as one hour or longer	Variable	Nonspecific** abnormalities; interseizure tracing may be normal
Petit Mal	Usually between 4 and 8 years; rarely before 3 or after 15	Simple staring (most frequent) Staring with clonic movements Staring with automatisms	Always brief (momentary)	Daily, frequently as many as 50 to 100 per day	Diffuse, bilaterally synchronous spike and wave forms usually recurring at frequency of 3 per second
Psychomotor (temporal lobe)	Most commonly in older children and adults	Manifestations vary considerably; most commonly automatisms consisting of staring episodes with smacking of lips, chewing movements, mumbled speech, confused states, bizarre motor and/or psychic performances	Usually lasts several minutes or so	Daily in many patients	Epileptiform discharges, usually spikes, from the anterior temporal areas in most patients, particularly in the older child and adult. In some patients, the EEG reveals other types of electrical abnormalities; occasionally interseizure tracing is normal
Myoclonic Infants	During the first year of life, most commonly between 3 and 9 months	Flexor spasm of musculature resulting in massive myoclonic seizure in recumbent position, and head dropping attack in sitting position; extensor spasm of musculature occurs less often	Individual spell very brief, several seconds or so, spells frequently recur in clusters lasting several minutes	Usually daily	Hypsarhythmia
Myolconic Older Children	Afer 2 years of age, most commonly between 3 and 7 years	Flexor spasm of musculature resulting in head dropping attack when mild, and precipitous fall forward when severe; extensor spasm of musculature occurs less often	Very brief, several seconds or so	Daily, weekly	Modified hypsarhythmia

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Note. From S. Livingston, *Comprehensive management of epilepsy in infancy, childhood and adolescence*, 1972. Reprinted Courtesy of Charles C Thomas, Publisher, Springfield, Illinois.

* This classification is currently employed at the Samuel Livingston Epilepsy Diagnostic and Treatment Center.

** By nonspecific, we mean electroencephalographic abnormalities other than (1) the classic, diffuse, bilaterally synchronous spike-wave forms which usually recur at a frequency of 3 per second, and (2) hypsarhythmia. These two electrical abnormalities are, in our experience, found in essentially all patients with petit mal epilepsy and myoclonic epilepsy, respectively. Electrical abnormalities, usually consisting of spikes, localized to the anterior temporal areas are relatively specific for psychomotor (tmporal lobe) epilepsy. These electrical aberrations are occasionally observed in the electroencephalograms of patients who present clinical evidence of other types of epilepsy, particularly major motor epilepsy.

A seizure is sometimes preceded by an *aura* or brief warning that an attack will follow. In fact, the aura is actually a part of the seizure. The aura may take many forms: (1) sensory auras, which may be manifested by a "funny feeling in my stomach," dizziness, tingling sensation, or impaired vision; (2) psychic auras, examples of which are anxiety, fears, confusion, and aberrant behavior; and (3) motor auras, which include movements of the limbs, twitching, or jerking movements resulting from contractions of the skeletal muscles. Auras can be very helpful to a child by warning him or her that a seizure is imminent, thus allowing time to prevent a fall. (They may also provoke an anticipatory fear reaction.) Clearly identifiable motor auras have also been used in behavior modification programs designed to suppress seizures (Zlutnick, Mayville, & Moffat, 1975). In one study, upon observing an aura, teachers and parents were able to prevent the seizure by simply holding the child and firmly saying, "stop." Although this appears to be a promising new technique for some children with uncontrolled seizures, much research remains to be done in this area (Mostofsky & Balaschak, 1977).

Sometimes children will have one seizure after another *(status)* or one long seizure *(prolonged)* for an extended period of time (Livingston, 1978b). These can be frightening experiences for teachers, parents, and direct care personnel in residential facilities. *Grand mal status*, commonly referred to as *status epilepticus*, is one complete grand mal seizure after another which continues from many hours to several days. The child does not completely regain consciousness between seizures. As the seizures persist, the child becomes more comatose, dehydrated, and exhausted. Most children experiencing grand mal status recover, however, death is possible. If the child regains consciousness between attacks, the condition is referred to as *serial grand mal seizures*. They are frequently associated with the abrupt withdrawal of antiepileptic medication. *Prolonged grand mal seizures* differ from status in that the child experiences one long seizure lasting a few hours or even longer. The seizure is a prolongation of the tonic or clonic phase, usually the latter, followed by a longer than usual postconvulsive state. Prolonged grand mal seizures differ from grand mal status in that the people experiencing the former do *not* have a recurrence of either the tonic or clonic phase after the seizure has terminated. Prolonged grand mal seizures are associated with both diseases of the brain (e.g., meningitis and encephalitis) and epilepsy.

Grand mal status and prolonged grand mal seizures are genuine medical emergencies, and caretakers should respond accordingly. Serial grand mal seizures, on the other hand, are not life threatening but should receive immediate medical attention.

Petit Mal Seizures (Absences)

Petit mal seizures (absences) are typically manifest as a sudden, brief loss of consciousness. The child stares vacantly into space for several seconds, and occasionally the eyes will roll back. The actual seizure lasts from 5 to 30 seconds, with up to 50 or 100 "spells" per day. Petit mal spells may come in groups or "showers" particularly within a few hours after awakening in the morning. In some cases, the staring episodes are accompanied by slight clonic movements (sudden contraction of the muscles) involving the eyebrows, eyelids, head, and arms at a rate of a rate of three per second. There may be rhythmic blinking of the eyes. Petit mal seizures may also be associated with *automatisms* which are motor acts that appear purposeful but are exhibited in the wrong setting. Some examples of automatisms in children are chewing and swallowing movements, lip smacking, and mumbled speech. These are not to be confused with psychomotor seizures which are also manifested by automatisms.

Although many educators are aware of the terms *grand mal* and *petit mal*, true petit mal seizures are not very common. Only 2 to 3% of all individuals with epilepsy and 6 to 12% of the children with convulsive disorders have petit mal spells (Currier, Kooi, & Saidman, 1963). Petit mal seizures are truly a disorder of childhood. The most common age at onset is between 4 and 8 years, and the disorder rarely lasts beyond late adolescence. Few children with petit mal epilepsy are brain damaged or mentally retarded.

There is such a thing as petit mal status in which the child experiences almost continuous petit mal spells that may last from an hour up to a day or longer. Livingston, Torres, Pauli, & Rider (1965) reported on a series of 117 patients with petit mal spells. Of the 111 who did not have evidence of brain damage prior to the onset of seizures, seven later exhibited intellectual impairment. Six of these children had frequent epi-

sodes of petit mal status. Although the causal mechanisms are unknown, Livingston feels the relationship merits consideration.

In the case of petit mal seizures, the EEG findings are particularly diagnostic (three per second spike-wave forms). This abnormality is detected in most children in the resting state but can be easily induced by a few minutes of hyperventilation. Petit mal spells are *never* preceded by an aura or followed by a postconvulsive state.

Many children with petit mal spells later develop other types of seizures, typically grand mal, during adolescence. The highest incidence rates are for children between 10 and 13 years of age (Livingston, Torres, Pauli, & Rider, 1965). The probability that a child will develop another seizure disorder is influenced both by the drug regimen and the age at onset of petit mal episodes. Livingston et al. compared the drug regimen for two groups of children treated for petit mal seizures. One group was administered a drug specifically for petit mal, and the other group received both a petit mal and grand mal agent. Of the group treated with only the antipetit mal drug, 81% later developed grand mal seizures, compared to 36% of the children receiving both a grand mal and petit mal agent.

As noted, the other variable that increases the probability of developing other types of seizures is age at onset. Generally, the older the child at the time of the first petit mal spell, the greater the likelihood that another convulsive disorder will eventually develop. It is noteworthy that children who do develop grand mal seizures subsequent to petit mal spells have major motor seizures that are generally not as frequent, less severe, and easier to control with pharmacotherapy, compared to other children with grand mal epilepsy.

Psychomotor (Temporal Lobe) Seizures

Psychomotor (temporal lobe) seizures are manifest in a variety of ways including changes in behavior, mood, or sensations. These changes are associated with a clouding of consciousness and a complete or partial loss of memory for what happened during the seizure. Just about every conceivable behavioral aberration has been described in the literature at one time or another as a manifestation of psychomotor seizures. In view of this, epileptologists have adopted more stringent criteria for the classification of psychomotor seizures, limiting diagnosis to "well-defined, classical seizure patterns" usually in combination with characteristic EEG discharges (Livingston, 1972).

Before aberrant behavior is considered a manifestation of epilepsy, it must also be accompanied by epileptiform EEG findings during the behavior in question. If the child's EEG reading is also abnormal between the behavioral events that are under investigation, the diagnosis of "behavioral disorder with abnormal EEG" is assigned. It is noteworthy that just because a child with an abnormal EEG concomitant with a behavior disorder responds to anticonvulsants does not mean he or she has epilepsy. Child and family expectations about improvement with medication can produce behavioral change. Well controlled, double blind studies have failed to support the effectiveness of anticonvulsants in the treatment of behavior disorders. However, Schain (1975) is of the opinion that the possibility of convulsive disorder should not be ruled out until further research is done in this area.

Livingston (1972) classified the pyschomotor seizures of children into four categories based on their outward appearance (clinical features):

1. *Arrest of activity with staring.* The staring episode is usually brief but longer than petit mal spells. A differential diagnosis can be made from EEG findings. This type of psychomotor seizure may last up to 5 minutes.

2. *Arrest of activity with staring followed by simple and/or complex automatisms.* Immediately following the staring episode, the child exhibits automatisms. As already discussed, these are behaviors that appear to be purposeful but are clearly out of context. Some examples are mouth movements (e.g., chewing, lip smacking, drooling, and vocalizations such as mumbling or humming). If the seizure does not terminate at this point, it may be followed by more complex automatisms. Some examples are picking at clothing or attempting to undress, handling objects, searching for things, moving around, and bizarre or abnormal behavior. Automatisms are typically stereotyped behaviors varying little from seizure to seizure. These episodes usually last a few minutes, but, as with other types of seizures, there is considerable variability in duration from one person to the next. Awareness is almost always impaired to some degree during the seizure, and there is no recollection of the attack when it is

over. Complex automatisms may include aggressive and antisocial acts. Diagnosis may be quite difficult in the case of seizures that simulate behavior disorders. Livingston points out that psychomotor seizures start abruptly without any apparent precipitating event, and there is usually no recollection of the attack. Behavior disorders, on the other hand, are often preceded by some triggering event and the person usually remembers what he or she has done.

3. *Arrest of activity with staring followed by pulling of the head and body to one side with concomitant automatisms.* Following a brief staring episode, the muscles appear to tighten as the head and body turn to one side, and an arm may extend in the direction of the turn. As stated, this rotary movement is accompanied with simple automatisms that may become complex if the seizure does not terminate immediately. The entire attack may be brief, lasting from 30 seconds to several minutes. The child typically does not remember what happened during the seizure.

4. *Psychic seizures.* These consist of a variety of sensations (e.g., tingling, numbness, sensations of hot and cold, pleasure), distorted thought (e.g., hallucinations, delusions), and changes in mood (e.g., laughing, crying). This is certainly one of the more tenuous types of epilepsy, and in the absence of clear EEG dysfunction, a diagnosis of psychomotor epilepsy is questionable.

Psychomotor (temporal lobe) seizures are rarely found in children under 6 years of age. More commonly, they are exhibited in older children, adolescents, and young adults with a prevalence of 10 to 20% in older children with convulsive disorders (Gold, 1974; Livingston, 1972). It should also be pointed out that, as with grand mal epilepsy, psychomotor seizures may be preceded by an aura and followed by a postconvulsive state.

Although not very common, there is such a condition as prolonged psychomotor seizures. For the most part, they are unresponsive to anticonvulsant drugs and are self limiting. The child should be watched during such an episode, and measures should be taken to prevent injury.

Myoclonic Seizures

Myoclonic epilepsy is the fourth major group of convulsive disorders proposed by Livingston which he further subdivided according to age at onset: infancy and early childhood. This is elaborated below. Myoclonic seizures are manifested by a twitching or jerking of skeletal muscles—usually of the head, neck, and arms. Generally, they are sudden flexor spasms. An individual muscle may contract or an entire limb may be involved. There is no apparent loss of consciousness during the attack. These seizures may occur a few at a time or in a series one after another. What the seizure will look like depends upon the age of the child and position of the body when the seizure begins. A variety of different terms are used to denote seizures associated with myoclonic epilepsy, and some clinicians make distinctions among the seizures as separate types of myoclonic epilepsy.

Myoclonic epilepsy of infancy (also known as *infantile spasms, hypsarhythmia, massive myoclonic seizures)* develops during the first year, usually between the third and ninth month. If the child is lying down, seizures may take the following form: flexion of the head forward, outward thrust of the arms, and flexion of the thighs up on the abdomen. It may be quite difficult to discriminate these seizures from normal infant activity or colic. The seizures are very brief, lasting a few seconds, and some infants may have up to 100 seizures per day. Seizures are exhibited in rapid succession, lasting from 1 to 2 minutes with no apparent loss of consciousness. If the infant is sitting, the spell may be manifest as a sudden forward jerk of the head accompanied by an outward thrust of the arms (head dropping or head nodding spells).

Myoclonic epilepsy of older children develops after 2 years of age, usually between 3 and 7 years. The seizure pattern in the sitting position is similar to that described for infants who are able to sit. The head suddenly jerks forward (occasionally backward), and the arms are thrust outward. If the child is holding an object, it may drop from his or her hands or, in some cases, may be thrown across the room. Again, these are referred to as "head-nodding" or "head-dropping" spells by some clinicians. In the standing position, the sudden flexor spasm, often associated with an outward thrust of the arms, frequently results in a vehement fall forward. However, the child is usually able to get up right

after the attack. Such falls often result in lacerations of the forehead, nose, and chin. To prevent such injuries, the child can wear protective head gear similar to a football helmet. Such attacks usually occur on a daily basis. Although each individual spell may last only a few seconds, they often occur in groups or showers lasting several minutes. This type of seizure may be referred to in the literature as *akinetic, atonic-akinetic, petit mal variant,* or *Lennox-Gastaut syndrome* (Gastaut, 1971; Gibbs, 1971).

It is noteworthy that children with myoclonic epilepsy frequently have other types of seizures as well, particularly grand mal. Also, staring spells that appear similar to petit mal may precede myoclonic seizures or occur independently of other attacks.

Jeavons (1977) argued that there may be as many as six different types of myoclonic epilepsy, four of which are noted here. One type, infantile spasms, is similar to Livingston's category, myoclonic epilepsy of infancy. However, Jeavons divides myoclonic epilepsy of older children into two groups. The children in one group have a mixture of seizures. They include sudden falls that may or may not be preceded by violent jerks (drop seizures), absence seizures that are characterized by a cessation of motion *(akinetic),* blinking of the eyelids, and upward movement of the eyes, head nodding seizures, sagging (atonic) or loss of posture *(astatic),* and tonic-clonic (grand mal) seizures. Children exhibiting this seizure pattern are usually mentally retarded. The attacks may be so frequent that the child fears walking alone. Children in the second group exhibit only myoclonic jerks, and mental retardation is rare.

Jeavons considers adolescents who develop myoclonic jerks, typically involving the shoulders and arms, as a fourth type of myoclonic epilepsy. The jerks are bilateral (e.g., simultaneous flexor spasms in both arms). Seizures begin around puberty and are often associated with menstruation. Intelligence is usually normal.

Niedermeyer (1974) reported a 2 to 3% prevalence figure for myoclonic epilepsy of older children (Lennox-Gastaut syndrome, petit mal variant) in a very active seizure clinic with a special interest in seizure surgery. He feels the actual prevalence in the general epileptic population is much lower, but the disorder is relatively common in residential facilities for mentally retarded children.

Because few followup studies have been conducted on children with myoclonic epilepsy, little can be said about how the disorder changes during adolescence and adulthood. Livingston (1972) found that many of the children whose seizures began in infancy continued to experience them into childhood. Niedermeyer (1974) reported the seizure pattern may be quite irregular, making the evaluation of drug effectiveness difficult. The older child may have a complete cessation of attacks for several years.

The EEG of infants with myoclonic seizures "gives the impression of nearly total disorganization of cortical voltage regulation" (Livingston, 1974, p. 543). The actual EEG pattern is referred to as *hypsarhythmia.* This pattern changes to modified hypsarhythmia as the child gets older.

Most infants diagnosed as having myoclonic epilepsy show clear evidence of brain damage prior to the onset of seizures, and almost all are severely mentally and/or motorically retarded. For the older children, the incidence of specific brain damage prior to the onset of seizures and the severity of mental retardation is much less than for the infants. The earlier the onset of these seizures, the poorer the prognosis in terms of mental retardation and motor development. "It has been our experience that the most serious hazard of childhood myoclonic epilepsy is not the seizures *per se,* but the associated mental retardation" (Livingston, 1972, p. 84).

Autonomic Seizures

The fifth category of convulsive disorders is *autonomic* epilepsy (also known as *hypothalamic* epilepsy, *abdominal* epilepsy, and *epileptic equivalent*). Seizures may manifest themselves as periodic episodes of abdominal pain, nausea, vomiting, and headache. When these symptoms precede a seizure (i.e., aura) or follow an attack as part of the postconvulsive phase, they are obviously seizure manifestations. However, when these symptoms appear in the absence of other clearly identifiable seizure patterns, diagnosis may be quite difficult. This type of seizure disorder is rare in children, and care must be taken to differentiate autonomic attacks from functional disorders and childhood migraine (Livingston, 1972; Walsh, 1974).

Febrile Seizures

There are a number of disorders that appear similar to epilepsy because they involve a loss of consciousness, are episodic in nature, or involve

convulsive body movements. Febrile seizures are one such disorder, and, because these attacks are relatively common among young children, they are included in this discussion. The term *febrile* means fever, and *febrile convulsion* simply refers to seizures associated with a febrile illness.

Based on several studies of a large number of young children exhibiting seizures in association with fever, Livingston (1972) identified two disorders: *simple febrile convulsions* and *epileptic convulsions precipitated by fever.* Simple febrile convulsions usually have their onset between 9 and 18 months of age and rarely begin after the child is 5 years old. They are associated with childhood illnesses that do not involve the brain, such as upper respiratory infections, otitis media (inflamation of the middle ear), and pneumonia (Nelson & Ellenberg, 1978). The convulsions are always generalized (usually grand mal) and are brief, lasting no longer than a few minutes. Typically, the child has only one seizure per illness, and it occurs between 2 to 6 hours after the onset of the fever. The prognosis for simple febrile seizures is excellent. Most children only have one to three seizures per year and the disorder rarely lasts beyond 6 years of age. Simple febrile seizures are relatively common. In one massive followup study of approximately 54,000 children, it was reported that 3.5% of the White children and 4.2% of the Black children experienced at least one febrile seizure (Nelson & Ellenberg, 1978).

Epileptic seizures associated with fever (atypical febrile convulsions) are quite different from simple febrile seizures in terms of treatment and prognosis. According to Livingston (1972), the diagnosis of atypical febrile convulsion is made if the child has one or more of the following: prolonged seizures, focal convulsions of any duration, febrile convulsions after the age of 5, and EEG findings that are characteristic of epilepsy. The prognosis for children with epileptic seizures associated with fever is similar to other children with epilepsy.

Although this classification scheme may create the impression that children with convulsive disorders fall neatly into a given category, such is not the case. Children may have more than one type of seizure disorder during the same period of time, or one form of epilepsy may be followed by another later in life. As noted previously, petit mal spells in childhood may be followed by grand mal convulsions in adolescence or early adulthood. Prevalence figures for mixed epilepsy (more than one kind of seizure) vary ranging from 40 to 60% of the people with convulsive disorders (Epilepsy Foundation of America, 1975).

In an attempt to standardize the terminology and facilitate research, the International League Against Epilepsy developed a classification scheme for the epilepsies based upon clinical and electroencephalographic data (Gastaut, 1970). A simplified version of that report appears in Appendix C. The two major subgroups are: *generalized* seizures, in which the electrical discharge affects the entire brain, and *partial* seizures, in which only a certain area of the brain is involved. Comparisons between Livingston's classification scheme and the one proposed by the League can be made quite easily. The major differences are that Livingston refers to massive epileptic myoclonus, infantile spasms, and akinetic seizures collectively as myoclonic epilepsy, and groups focal seizures with grand mal. In the League's classification scheme, focal attacks are "partial seizures with elementary symptomatology." Most physicians do not strictly adhere to the League's classification scheme and the terms adopted by Livingston are more commonly used to identify different types of epilepsy.

Unfortunately, verbal descriptions of seizures are a far from satisfactory means of education. To give teachers a better idea of what the different types of seizures look like, I have used several films that are of value in this regard. One film, *Modern Concepts of Epilepsy* (Ayerst Laboratories) is now somewhat dated but is quite useful in its graphic presentations of a variety of seizures. Another film that features Dr. Livingston, *Diagnosis and Medical Management of Epileptic Seizures* (Ayerst Laboratories), was developed to train pediatricians about epilepsy. With appropriate preparation, it is also an excellent film for graduate level teacher training programs as is *Complex Partial Seizures* (Geigy Pharmaceuticals). A number of other films about epilepsy have been made, and information about their content and availability can be obtained from the Epilepsy Foundation of America.

SEIZURES IN THE CLASSROOM

For teachers, direct care personnel in residential facilities, and many other caretakers, a grand mal seizure can be a frightening experience. Because there have been conflicting opinions about how best to care for a person during a grand mal

seizure, some confusion may exist as to what is the proper thing to do. The following steps should be taken during the course of a convulsion:

1. Remove any objects that the child may strike during the clonic phase (jerking movements) of the seizure.
2. Loosen restricting clothing.
3. Turn the child on his or her side. (This will allow saliva and vomitus to flow out of the mouth instead of being aspirated.)
4. *Do not* try to restrain the child's movements during the active (tonic-clonic) phase of the seizure.
5. *Do not* try to move the child during the active phase of the seizure.
6. *Do not* insert any objects into the child's mouth.

In case there is any confusion regarding the last point, the following quote from Lombroso (1974) is quite emphatic:

> Most convulsive seizures are self-limiting events terminating on their own accord before specific medical treatment need or can be rendered. For these, positioning to prevent aspiration of excessive secretions and vomitus and prevention of self-injuries is generally sufficient. Prying open clenched teeth for the insertion of time-honored tongue blades, pencils or fingers has no place in modern medicine. These maneuvers are useless in the prevention of tongue biting (that will have occurred at the onset of the initial tonic phase), but may actually be harmful by dislodging loose teeth, and by initiating nociceptive stimuli that reflexly can prolong the tonic phase. Likewise excessive restraining of convulsing patients may facilitate bone injuries. (p. 536)

Because there is some disagreement among epileptologists regarding the prevention of tongue and cheek biting (Livingston, 1978b), the following procedure is suggested for school personnel. In those *rare* cases in which the physician recommends that an object be placed in the child's mouth to prevent self injury, specific instructions should be obtained from the doctor on how this situation should be handled and by whom. Simply asking the parents if any special procedures are required to keep the child from hurting himself or herself during a seizure can allay fears about what the school should do.

Many children will be able to resume classroom activities shortly after the convulsion. However, some children lapse into a deep sleep. Attempts to awaken the child are futile, and he or she should be allowed to sleep. Upon awaking, the child may be confused, afraid, upset, or exhibit unusual behavior. Scolding is of little value. If the child's postconvulsive behavior is self injurious or harmful to others, appropriate measures must be taken. The same holds true for psychomotor seizures if complex automatisms are manifest as behavior disorders. Fortunately, attitudes about epilepsy have changed over the last half century, and attempts to conceal the disorder are not as pervasive as they once were. The school should definitely be informed of the convulsive disorder even if medication keeps the seizures completely under control. The awareness that a child has epilepsy *may* cause some apprehension for school personnel especially if they are not informed about the type of seizure and degree of seizure control with medication or have not been in such a situation before (Force, 1965). To repeat, the easiest thing for the teacher to do is simply ask the parents what they do when their child has a seizure.

Unfortunately, space constraints do not permit a discussion of the psychosocial aspects of epilepsy. However, it must be emphasized that the teacher's reaction to a seizure greatly influences how classmates respond to the child with epilepsy. In the case of a child with uncontrolled seizures, the teacher can explain the disorder to the class (if necessary, in the child's absence), and even use classroom activities that sensitize students to the needs of exceptional children. It is the unexpectedness of the seizure and alarmed reaction of the teacher and peers that makes the situation tragic. Much of this can be avoided with a little preparation. Many teachers have shared with me anecdotes of how grand mal seizures can be made quite uneventful with appropriate peer sensitization and personal conversations with the epileptic child.

The probability of encountering children with uncontrolled seizures is greatly influenced by the educational setting. In regular elementary and secondary schools where less than 1% of the students are treated for epilepsy, the probability is low. Considering that at least 50% of such children are seizure free if they take their medication regularly, a grand mal seizure at school may be a rare event. However, Force (1965) reported that a third of the nonspecial education teachers

in his survey had witnessed a seizure at school as did over 80% of the special education teachers. In another study, over half of the teachers had direct experience with grand mal seizures in their classrooms for mentally retarded (Gadow, 1978a). For special education settings, the proportion of children treated for convulsive disorders who have seizures at school ranges from 27% in early childhood classes to 41% in programs for trainable mentally retarded children (Gadow, 1976; 1978a). It is possible that the recent emphasis on deinstitutionalization, mainstreaming, and least restrictive alternative will bring many more people into contact with children who have seizures.

MEDICATION FOR DIFFERENT KINDS OF SEIZURES

By far the most common treatment for convulsive disorders is drug therapy. Generally speaking, antiepileptic drugs are capable of rendering 50% of the children with epilepsy seizure free. Another 25% have fewer and less severe seizures, leaving approximately 15% of the treatment population who are not helped with medication. Unfortunately, of the children with intractable (uncontrollable) seizures, only a small percentage are good candidates for surgery, a treatment rarely employed with children. Unless the exact location of the abnormal electrical discharge (focus) can be identified, surgery is often impractical. Even when surgery is successful, antiepileptic medication must continue to be administered. Other types of treatment are sometimes used. For example, a special diet may be quite helpful for the child with myoclonic epilepsy. A relatively new surgical technique involves placing inside the body a small electrical device that stimulates the cerebellum, thus inhibiting seizures (Cooper, Amin, Riklan, Waltz, & Pool, 1976). As noted previously, there is now much interest in investigating psychological treatments for controlling seizures such as psychotherapy, behavior modification, and biofeedback (Mostofsky & Balaschak, 1977). Although some children may benefit from nondrug treatments, this section will focus on medication, in keeping with the orientation of this text.

Bromides were found to be useful agents in the treatment of epilepsy in 1853, and phenobarbital was introduced in 1912 as an anticonvulsant (Livingston, 1972). For many years, these were the only drugs that were truly effective in the control of seizures. Because bromides and phenobarbital often produced sedation (drowsiness, lethargy) at the same dosages required to control attacks, they were far from satisfactory for all people with epilepsy. In a paper published in 1937, Putnam and Meritt observed that little progress had been made to develop more effective anticonvulsants. They also reported that Dilantin (phenytoin), among other drugs they were investigating, had anticonvulsant properties in laboratory animals. Shortly thereafter, Dilantin was found to be quite effective in controlling grand mal attacks but had little effect on petit mal spells (Merritt & Putnam, 1938). It was not until 1945 that the first effective antipetit mal drug, Tridione (trimethadione) was discussed in the literature (Lennox, 1945). Today there are hundreds of drugs known to have anticonvulsant properties; however, less than two dozen are used with any frequency, and three or four drugs account for most of all medication used in the management of epilepsy. Before discussing the effects of Dilantin, Tridione, and other more recently developed agents, it should be emphasized that many antiepileptic drugs are truly miracles of modern pharmacological research.

The commonly prescribed drugs for the control of seizures consist primarily of five groups of anticonvulsants (see Table 3–2). The drugs within each group have similar properties. A sixth category of agents, made up of psychotropic and assorted other drugs, have anticonvulsant properties but are also used for the treatment of other disorders.

As previously stated, the various types of seizures respond most favorably to different types of anticonvulsants. Employing the same rationale for adopting Livingston's (1972) classification scheme for seizures, the results of his research on the safety (risk-to-benefit ratio), and efficacy (effectiveness in suppressing seizures) of anticonvulsant drugs is presented here. In Table 3–3, drugs are listed in order of preference for each of the four major groups of convulsive disorders. For the fifth group, autonomic seizures, the drugs of choice are the same as those for major motor (grand mal) seizures.

Major Motor (Grand Mal)

Phenobarbital is the drug of first choice in the treatment of grand mal seizures. It is both the least toxic and least expensive of the major anticonvulsants. However, there is disagreement about the selection of phenobarbital as the first

TABLE 3–2

Anticonvulsant drugs grouped according to similarities in chemical structure.

Barbiturates
Gemonil (metharbital)
Mebaral (mephobarbital)
Mysoline (primidone)
phenobarbital

Hydantoinates
Dilantin (phenytoin)
Mesantoin (mephenytoin)
Peganone (ethotoin)

Succinimides
Celontin (methsuximide)
Milontin (phensuximide)
Zarontin (ethosuximide)

Oxazolininediones
Paradione (paramethadione)
Tridione (trimethadione)

Benzodiazepines
Clonopin (clonazepam)
Valium (diazepam)

Other Drugs
ACTH (corticotropin) and Corticosteroids
Atabrine (quinacrine)
bromides
Depakene (valproic acid)
Dexedrine (dextroamphetamine)
Diamox (acetazolamide)
Phenurone (phenacemide)
Tegretol (carbamazepine)

TABLE 3-3

Drugs currently used at the Samuel Livingston Epilepsy Diagnostic and Treatment Center for the control of epileptic seizures*

Major Motor (Grand Mal)	Petit Mal (Absence)	Psychomotor (Temporal Lobe)	Myoclonic	
			Infants	Older Children
PHENOBARBITAL (Mephobarbital)[1]	ZARONTIN	TEGRETOL	ACTH and CORTICOSTEROIDS	KETOGENIC DIET[6]
MYSOLINE	DEPAKENE[3]	Mysoline		ACTH and CORTICOSTEROIDS
DILANTIN	Tridione[4]	Dilantin		
Tegretol	Paradione[4]	Mesantoin[2]		Valium
Bromide (for young children)	Celontin	Phenurone[2]		Bromide
Peganone	Milontin			Clonopin
Gemonil	Dexedrine			Depakene
Mesantoin[2]	Atabrine[5]			
Dexedrine (for sleep seizures)				
Diamox (for menstrual seizures)				

Note. Modified from Livingston, S. *Comprehensive management of epilepsy in infancy, childhood and adolescence.* 1972. Reprinted courtesy of Charles C Thomas, Publisher, Springfield, Illinois.

* Arranged in order of our preference, based on relative efficacy and toxicity.

[1] We use this drug almost exclusively as a substitute barbiturate for patients whose seizures are benefitted by dosages of phenobarbital that produce side reactions, such as marked drowsiness or hyperactivity.

[2] These drugs possess potent anticonvulsant properties, but because of pronounced toxicity, they should be prescribed only to patients whose seizures are refractory to all other antiepileptic agents.

[3] Based on limited but encouraging experience.

[4] These drugs are very effective in controlling petit mal spells, but they appear to be potent teratogens. All other antipetit mal agents should be given an adequate trial before prescribing these drugs to females of child bearing age.

[5] Atabrine is effective in the treatment of some cases, but its value is limited because it causes a yellowish discoloration of the skin in most patients.

[6] The Ketogenic diet is included because of its exceptional value in controlling this form of epilepsy.

agent to be tried. Some experts feel it should be Dilantin because it is a more powerful drug. Livingston's (1972) opinion is that the large number of side effects associated with Dilantin makes it less desirable and that it should not be recommended for treatment in infants, adolescent females, and children undergoing orthodontal care. The rationale for these exclusions are: (1) it is difficult to evaluate side effects in infants; (2) the possibility of excessive growth of body hair and gum tissue makes it undesirable for females; and (3) the growth of gum tissue interferes with orthodontal treatments. Because phenobarbital may cause hyperactivity or irritability as a side effect, Mebaral (mephobarbital) is listed as a possible alternative. Mysoline (primidone) is the second most preferred agent for the treatment of grand mal epilepsy. Noteworthy is the fact that one of the metabolites of Mysoline is phenobarbital. Diamox (acetazolamide) is recommended for the management of major motor seizures associated with menstruation.

Prolonged grand mal seizures, serial grand mal seizures, and grand mal status (status epilepticus) can be treated with intravenous injections of Valium (diazepam), paraldehyde, or barbiturates in an attempt to stop the seizure (Livingston, 1978b). To repeat, a child experiencing any of these three types of prolonged seizures should receive immediate medical attention. Grand mal status, in particular, is a serious medical emergency.

Petit Mal

The drug of first choice for the treatment of petit mal seizures is Zarontin (ethosuximide). It was first reported to be an effective agent for this type of seizure in 1958 (Zimmerman & Burgemeister, 1958). Although extremely effective in the control of petit mal seizures, it is of little importance for other types of attacks. Because of the high percentage of children with petit mal epilepsy who develop other types of seizures later on, Livingston (1972) recommended the following regimen:

> Drug treatment should be initiated with phenobarbital as a prophylactic measure for the control of grand mal seizures. The physician observes if phenobarbital is well tolerated in terms of side effects and to see that it does not increase the frequency of petit mal spells. If phenobarbital is unsatisfactory, other grand mal agents (Mysoline, Mebaral) are tried. Because Dilantin may exacerbate petit mal attacks, it is tried only after other agents have failed. Once the child has adjusted to the grand mal agent (after about 1 month of treatment), the petit mal drug is started. Zarontin should be tried first. If this fails to control the petit mal seizures, then other drugs must be attempted (see Table 3–3). Drugs for both the control of grand mal and petit mal seizures are maintained until the child has been seizure free for at least 4 years. If the EEG no longer shows the characteristic petit mal pattern, the dosage of the petit mal drug is gradually reduced over a 6 to 12 month period. The grand mal agent is continued until the age of 14. If the child has not developed grand mal epilepsy by then, the dosage of the grand mal drug is reduced over a one year period, and treatment is terminated.

Other anticonvulsant drugs are also recommended for the treatment of petit mal epilepsy. Millichap (1972), for example, reports that Diamox is equally as effective as Zarontin and causes fewer side effects. However, some clinicians report that Diamox produces only temporary seizure control in many cases (Livingston, 1978a). Clonopin (clonazepam) is another agent reported to be an effective antipetit mal drug (Mikkelsen et al., 1976). Depakene (valproic acid), approved by the FDA in 1978, is the most recent addition to the list of drugs proven effective in the control of petit mal spells (Gram et al., 1977; Jeavons & Clark, 1974). It may soon become one of the more frequently prescribed drugs for this type of epilepsy.

Myoclonic

Because myoclonic epilepsy is often unresponsive to medication, this disorder with its concomitant mental retardation may be a trying experience for the family. Huttenlocher, Wilbourn, and Signore (1971) reported a case study about an 11 year old girl with myoclonic seizures who responded favorably to a special diet. However, repeated falls during childhood "led to widespread scarring of the face and chronic ulceration . . . of the skin over her forehead . . . . Uncontrolled seizures made school attendance impossible. She became withdrawn and self-conscious due to her disfigured face." The following quote from Niedermeyer (1974) aptly describes the serious-

ness of the situation from the standpoint of the physician:

> Desperate parents sometimes ask for *neurosurgical treatment* but in view of the wide spread EEG abnormalities, the neurosurgeon will have to resist, in most instances, the parental pressure to operate. *Institutionalization* is very frequently the result of the severe mental defects which may lay an unbearable burden on the life of an otherwise [illegible]lthy family. (p.92)

Obviously such a situation presents a number of risk-to-benefit questions about treatment itself. As Niedermeyer (1974) put it:

> Should the physician give medication at all? I feel one cannot negate this question, especially because of the psychological impact of total therapeutic passivity on parents and relatives. It may be wise to change medication from time to time, according to the general rules of such changes. . . . A dramatic struggle for a pharmacological enforcement of seizure-freedom has to be strictly avoided; these attempts always lead to drug toxicity and enhancement of mental dullness. (p.92)

Of all the types of epilepsy, myoclonic seizures carry the worst prognosis in terms of seizure suppression. In infants and young children, ACTH (corticotropin) and corticosteriods may be effective in the control of seizures (Livingston, 1972). However, the relapse rate is high, and there is no beneficial effect on mental performance. The best results are obtained with infants (less than a year old) when treatment begins soon after the onset of seizures.

Livingston (1978a) considers Valium to be the drug of first choice in the treatment of myoclonic epilepsy of older children. It is also the preferred agent for myoclonic epilepsy of younger children when steroid treatment is not started shortly after the onset of seizures. Unfortunately, the beneficial effects of Valium are often short lived. After a few months of treatment, children typically develop a tolerance for the drug's seizure controlling properties.

Clonopin is also effective in the treatment of myoclonic epilepsy (Fazio, Manfredi, & Piccinelli, 1973), and, like Valium, is a benzodiazepine. Clonopin was approved by the FDA in 1975. By the spring of 1977, it was prescribed as often as Valium for epilepsy in trainable mentally retarded children (Gadow, 1978a). Although the results of the initial studies on Clonopin were met with much enthusiasm, it has not proven to be as effective for myoclonic epilepsy as originally expected (Livingston, 1978a).

Livingston (1972) has been a strong advocate of the ketogenic diet in the control of myoclonic seizures especially in children between 2 to 5 years of age. Briefly, the diet prescribes that the amount (in grams) of fat consumed must be at least four times greater than the amount (in grams) of carbohydrates and protein combined. Although there are a number of problems inherent in this regimen, it has proven to be quite effective for many children with myoclonic (and grand mal) seizures. In some cases, however, the benefits of the ketogenic diet are short lived with a recurrence of seizures after several months of treatment. Two additional benefits of the diet are (1) a marked tranquilizing effect on epileptic children who are also hyperactive (even in the absence of seizure control) and (2) an avoidance of the adverse side effects associated with anticonvulsant drugs. The reader is referred to Livingston (1972, pp. 378–405) for a more detailed discussion.

Recently, interest has been generated about the use of medium chain triglycerides (MCT) to provide the necessary fat content in the ketogenic diet (Huttenlocher, Wilbourn, & Signore, 1971; Signore, 1973). Advocates maintain that the use of MCT permits a more palatable diet without loss of seizure control. Others, however, have not found the MCT diet to be as effective as the ketogenic diet in controlling myoclonic seizures (Livingston, Pauli & Pruce, 1977).

Psychomotor (Temporal Lobe)

The drug of choice in the treatment of psychomotor (temporal lobe) epilepsy is Tegretol (carbamazepine) (see Table 3–3). It was approved by the FDA for use in the treatment of epilepsy in 1974. Although it is considered superior to other agents in the control of psychomotor seizures (Livingston, 1978a), some clinicians report Dilantin and Mysoline are equally effective (Livingston, Pauli, & Pruce, 1978; Rodin, Rim, Kitano, Lewis, & Rennick, 1976).

Nocturnal (Sleep) Seizures

Nocturnal seizures typically occur soon after falling asleep or shortly before or after the usual time of awakening. These seizures are usually difficult to control with standard antiepileptic drugs

(phenobarbital, Dilantin, Mysoline). However, Dexedrine (dextroamphetamine) has been used successfully in the management of nocturnal seizures, especially those that occur shortly after falling asleep (Livingston & Pauli, 1975). It is noteworthy that after treating 10,000 epileptics with amphetamines, particularly Dexedrine, Livingston reports these drugs are remarkably free of side effects. He did not encounter drug addiction in a single case.

Febrile Convulsions

Perhaps one of the most debated topics in pharmacotherapy for convulsive disorders is the treatment of simple febrile convulsions. The source of the problem has a lot to do with the definition of febrile seizure. Because not all researchers use the same criteria, children with epileptic seizures precipitated by fever may be included in treatment samples. Another problem is parent compliance with the drug regimen (i.e., it is difficult to be certain if the treated group is really receiving medication). It is Livingston's (1972) position that drug treatment for simple febrile convulsions is neither necessary nor effective. Such seizures appear to be unresponsive to continuous antiepileptic drug treatment (e.g., with phenobarbital), and giving the child phenobarbital at the onset of a fever is of little value because the convulsion is often the first indication to the parent that the child has a fever. However, Livingston maintains that administering phenobarbital and aspirin at the onset of a fever may be useful because "it provides the parents with 'something to do' and may relieve some of their anxiety" (1972, p. 30).

Wolf et al. (1977) also found that when phenobarbital is given intermittently, it is no more effective in preventing febrile seizures than when no medication is administered. In contrast to Livingston, however, they found that continuous (daily) treatment with phenobarbital did significantly reduce the occurrence of febrile seizures. The major problems they encountered with prescribing phenobarbital for use on a daily basis were parental resistance and failure to give medication regularly and drug induced hyperactivity (see section on side effects). Attempts have been made to identify children who are at risk for developing epilepsy subsequent to febrile seizures (Nelson & Ellenberg, 1978). However, it is not known if continuous treatment with phenobarbital after the onset of febrile seizures will prevent the eventual development of epilepsy in high risk children. In general, "there is no empiric evidence that chronic treatment with anticonvulsant medication influences, positively or negatively, the long-term prognosis of children with febrile seizures" (Nelson & Ellenberg, 1978, p. 726).

Treatment of epileptic seizures precipitated by fever, on the other hand, should be initiated immediately and monitored like any other convulsive disorder. Considering the side effects associated with Dilantin, phenobarbital should be employed first in attempting to control seizures in infants.

In actual clinical practice, physicians may use drugs other than those employed by Livingston in the treatment of certain types of seizures. When frequently used agents fail to control seizures, other more powerful (and possibly more toxic) drugs may have to be administered. When conventional anticonvulsants do not appreciably alter seizure activity, the physician may have no other alternative than to try drugs with known anticonvulsant effects but not specifically approved by the FDA for the treatment of epilepsy. New and experimental drugs are typically first used with people whose seizures cannot be controlled with conventional anticonvulsants.

SIDE EFFECTS OF ANTIEPILEPTIC DRUGS

Unwanted antiepileptic drug reactions can be classified according to: (1) intoxication due to high levels of the drug in the blood, (2) common side effects that occur at normal dosages, and (3) idiosyncratic reactions that are unrelated to dosage (Kutt & Louis, 1972). The discussion of side effects focuses primarily on drug induced behavioral changes that impair performance and changes in bodily function that are observable to caretakers.

Barbiturates

The barbiturates (phenobarbital, Mysoline, and Mebaral) are among the most frequently prescribed drugs for epilepsy. Phenobarbital is the least likely to produce serious side effects of all the antiepileptics. Livingston (1972) commented after treating 15,000 patients with this drug, many for long periods of time, that "the only significant untoward reactions we have observed in our patients are drowsiness, hyperactivity and excitation simulating the hyperkinetic syndrome and an occasional rash" (p. 174).

Drowsiness is a common side effect of phe-

nobarbital, but in many children this reaction diminishes within a few weeks after the onset of treatment. If drowsiness persists, the physician may attempt to counteract it with a stimulant drug (e.g., Ritalin or Dexedrine). However, if the drowsiness does not abate, a decision will have to be made whether or not to select another agent. The pervasiveness of drowsiness with phenobarbital treatment among children with convulsive disorders is demonstrated in three separate surveys. In a study of 101 children receiving anticonvulsants in early childhood special education programs (Gadow, 1977b), teachers rated 36% as being more drowsy or sleepy than their peers. The figure for 241 mentally retarded public school children on medication for seizures is 37% (Gadow, 1978a). A survey conducted by the National Epilepsy League (Pietsch, 1977) found that 35% of the children on medication were considered drowsy by their parents. It should be emphasized that children may simulate drowsiness as a device for manipulating both parents and teachers. However, the consistency of these results across treatment populations indicates that this side effect has educational implications for a large number of children treated with anticonvulsants.

Another side effect of phenobarbital in children is behavior disorder, which may be manifested as irritability, aggressivity, excitability, overactivity, and hyperactivity. Livingston (1972) estimated that 15 to 20% of the children he treated with phenobarbital had this type of reaction. Similarly, Gadow (1977a) found that 20% of the preschoolers taking phenobarbital for epilepsy exhibited behavior problems as a result of medication. The prevalence of drug induced hyperactivity, aggressivity, and irritability in children treated for febrile seizures was 25% in one study (Thorn, 1975) and 42% in another (Wolf & Forsythe, 1978). In some cases, the behavior disorder is severe and becomes an even greater problem than the seizures. Wolf and Forsythe (1978) reported that phenobarbital treatment had to be discontinued in half of the children who developed this reaction. They also noted a relationship between this side effect and preexisting behavioral disturbance. Only 20% of the children whose behavior was normal before seizures began developed a behavior disturbance on phenobarbital compared to 80% for those who exhibited behavior disorders prior to the onset of seizures. In the latter group, phenobarbital seems to aggravate the situation. However, not everyone agrees that this side effect is more common in behavior disordered children (Livingston, 1976). Phenobarbital induced behavioral disturbances are *not* dose related, but rather represent a specific sensitivity to the drug. Livingston (1978b) suggested the physician should first see if Ritalin or Dexedrine is effective in controlling the behavior disorder. If unsuccessful, phenobarbital should be gradually replaced with Mebaral. If the behavior problems still do not abate, Mebaral should be substituted with Mysoline.

Skin rashes are rare with phenobarbital. In general, when antiepileptics do produce skin reactions, the physician discontinues the offending agent and substitutes another drug (Livingston, 1978b). Dosage reduction usually does not help because skin reactions are due to a specific sensitivity to the drug.

Compared to phenobarbital, Mebaral is much less likely to produce drowsiness or a hyperactivity reaction (Livingston, 1972).

The primary side effect of Mysoline is drowsiness, particularly when the drug is first taken. If the reaction is persistent, treatment may have to be discontinued. Other possible side effects (which usually disappear within a few weeks) are dizziness, *diplopia* (double vision), and *ataxia* (a staggered walk with a wide base, making a child appear as if he or she is drunk). *Dysarthria* (slurred speech), *nystagmus* (rapid, involuntary movement of the eyeball), and headaches are also side effects associated with either early treatment or overmedication. Measlelike rashes are occasionally reported with Mysoline treatment.

Hydantoinates

The hydantoinates (Dilantin, Mesantoin, and Peganone) have very powerful anticonvulsant properties, but they also are associated with a wide variety of side effects. Dilantin is the least toxic of the three and can be prescribed for long periods of time without any apparent discomfort (Livingston, 1972). Because Dilantin typically does not produce drowsiness, its discovery as an anticonvulsant was met with much enthusiasm.

Several disturbances are associated with overmedication (Dilantin *intoxication*). These include ataxia, diplopia, nystagmus, and dysarthria. However, these side effects can usually be managed with dosage reduction. Unfortunately, the dosage that is effective in controlling sei-

zure [illegible]o frequently borders on the level that pro[illegible]es intoxication.

E[illegible]ssive growth of gum tissue *(gingival hyper[illegible]a)* is also quite common, occurring in approx[illegible]ately 40% of those treated with Dilantin. Visually, the gums enlarge and, in severe cases, they grow over the surface area of the teeth, creating a mulberrylike appearance. Food particles and other irritants lodge in the gums causing them to redden or have a bluish cast. Meticulous oral hygiene and gum massage are often stressed. Although this can alleviate inflamation due to food particles, it does not slow down or lessen the growth of gum tissue (Livingston & Livingston, 1973). This reaction usually starts 2 to 3 months into treatment and is more common among children than adults. Livingston (1972) reported that the growth of gum tissue is *not* dose related, but there is some disagreement (Little, Girgis, & Masotti, 1975). The gums return to normal 3 to 12 months after medication is stopped, depending upon the severity of tissue growth. For some children who must be maintained on Dilantin, excessive gum tissue may have to be removed surgically. The growth of gum tissue alone is *not* sufficient reason to switch to other drugs. However, if the condition leads to emotional problems, disfiguration of the teeth, or related disorders, alternative agents may have to be sought out.

Hirsutism, or excessive growth of body hair, occurs in about 5% of the children treated with Dilantin. Change is most pronounced in arm and leg hair, but the face and trunk may also be affected. The reaction is irreversible, that is, even if medication is stopped the increased hair growth will remain. For cosmetic reasons this may be a problem for teenage girls.

Measlelike rashes are common with Dilantin beginning within the first 2 weeks of treatment. Such rashes are *not* dose related, and they clear up when medication is withdrawn.

Another skin reaction that has received attention recently is *coarse facies*, a thickening of the skin of the mouth, nose, and forehead (Falconer & Davidson, 1973). Reports of the prevalence of coarse facies range from 20 to 30% for mentally retarded persons receiving Dilantin in residential facilities (Herberg, 1977; Lefebvre, Haining, & Labbé, 1972).

The primary gastrointestinal side effect of Dilantin is constipation, which is often encountered in long term treatment.

The most common side effect of Mesantoin (mephenytoin) is drowsiness. Other untoward reactions are the same as those for Dilantin intoxication; however, they occur less often for Mesantoin. Rashes are also reported with this medication.

Peganone (ethotoin) is not a very powerful anticonvulsant, and is relatively free of side effects. Untoward reactions that have been reported include rashes, ataxia, diplopia, anorexia, nausea, drowsiness, headache, and dizziness.

Succinimides and Oxazolidinediones

The succinimides are used primarily in the management of petit mal spells and consist of three drugs: Zarontin, Celontin, and Milontin (see Table 3–2). Possible gastrointestinal side effects of Zarontin include abdominal pain, nausea, vomiting, anorexia (loss of appetite), and hiccups. Other reported side effects are drowsiness, headaches, dizziness, and behavioral disturbance. The side effects associated with Celontin and Milontin are similar to those of Zarontin. However, Celontin (methsuximide) and Milontin (phensuximide) are more likely to produce drowsiness.

The oxazolidinediones (Tridione and Paradione) are also antipetit mal agents. Photophobia, an aversion to bright light because it is irritating, is the most common side effect of Tridione. Other side effects include headache, diplopia, irritability, drowsiness, rash, nausea, abdominal pain, and hiccups. The untoward reactions associated with Paradione (paramethadione) are similar to those of Tridione.

Other Drugs

Although there was much concern initially about the side effects of Tegretol, Livingston (1978a) commented that after "12 years' experience with the use of carbamazepine in over 1,000 epileptic patients. . . . we classify it to be a relatively safe anticonvulsant drug" (p. 306). In one study of 255 epileptic patients treated with Tegretol, 11% became drowsy and 2% exhibited ataxia (Livingston, Pauli, & Berman, 1974). Patients either developed a tolerance for the drowsiness or the dosage was reduced. In all cases, ataxia responded to dosage reduction.

Side effects are frequently reported for Clonopin but rarely are they life threatening (*Medical Letter*, 1976). Severe drowsiness occurs in nearly half of the individuals treated with Clonopin, ataxia in about a third, and a quarter exhibit behavioral

disturbance (aggressivity, irritability, hyperactivity, and agitation). Other side effects include nystagmus, slurred speech, and dysarthria. "Since some patients with the types of seizures (myoclonic and akinetic) for which clonazepam is recommended are severely mentally retarded, the adverse effects of the drug on the patient's ability to perform personal tasks, walk, or communicate may outweigh the benefit of controlling seizures" (p. 19).

No attempt will be made to discuss the remaining agents with anticonvulsant properties in the "other drugs" category (see Table 3–2). The interested reader is referred to more comprehensive discussions of pharmacotherapy for convulsive disorders (Goodman & Gilman, 1975; Livingston, 1972; Niedermeyer, 1974; Stores, 1978; Woodbury, Penry, & Schmidt, 1972).

Blood, Liver, and Other Disturbances

Certain antiepileptic drugs have an adverse effect upon blood, liver, and kidney functions (Livingston, 1972; Reynolds, 1975). These agents must be monitored closely both through physical examinations and laboratory tests (Livingston, 1978b). Drugs known to produce blood disturbances in some individuals are Zarontin, Mesantoin, Paradione, Phenurone (phenacemide), and Tridione. Routine laboratory tests of kidney function must also be conducted for the latter three drugs as well. Liver function tests must be conducted for Tegretol and Phenurone. The physician may inform the epileptic child and/or his or her parents about the signs of possible disturbances to these body systems and request that they be reported immediately (Livingston, 1978b).

There is evidence that Dilantin, phenobarbital, and Mysoline interfere with the metabolism of *folic acid* in a small percentage of people receiving either one or a combination of these drugs (Livingston, 1972; Reynolds, 1975). Folic acid is needed by the bone marrow to form red blood cells. When this substance is not present in sufficient quantity, the newly formed red blood cells are much larger than normal, poorly formed, and quite fragile. This condition is called *megoblastic anemia*, and it always responds to treatment with folic acid. In some cases, however, folic acid treatment has increased seizure frequency.

Some investigators have reported abnormally low levels of calcium in the blood (hypocalcemia) and bone disorders such as *osteomalacia* and *rickets* in people receiving antiepileptic drugs, particularly Dilantin (Livingston, 1978b; Reynolds, 1975). It has been hypothesized that some anticonvulsants stimulate (induce) the metabolism of vitamin D. Thus, vitamin D is removed from the body at a greater rate than normal. Vitamin D is important to bone development because it greatly accelerates the absorption of calcium from the gastrointestinal tract. When the body becomes deficient in vitamin D, calcium is absorbed from the bones. If this situation persists over several months, almost all the calcium in the bones will be absorbed. Then the calcium in the extracellular fluid drops to very low levels. This condition is called *rickets*, and is characterized by a weakening of the bones, and, in the later stages, *tetany* (muscle spasms).

The prevalence of drug induced rickets and osteomalacia and the role of anticonvulsants is controversial. Most reports for these disturbances are in mentally retarded and/or institutionalized people (Livingston, 1978a). Livingston cited a study in progress that failed to show significant differences in blood calcium levels between epileptic patients on medication and a control group not receiving antiepileptic drugs. One patient who did show abnormally low levels of calcium was administered vitamin D. After reviewing the literature, Livingston concluded that for most people with epilepsy, exposure to sunshine during the summer months is a sufficient source of vitamin D. Patients who are at risk "are those who, because of motor difficulties, severe retardation, or institutionalization, are unable to take advantage of sunshine to form . . . vitamin D" (p. 442).

Cognition, Learning and School Performance

Surprisingly little research has been conducted on the effects of anticonvulsant drugs on learning, cognition, and school performance. Much of the information that is available appears as side effect reports in clinical trials or in case studies. Often, data on dosage, blood level, and rate at which the reaction occurs are omitted. Many studies are difficult to interpret because patients were on more than one drug. Following is a brief summary of the results of a few studies in this area and their implications for school performance. For more detailed discussions of cognitive side effects see the literature reviews by Livingston (1972) and Stores (1975, 1978).

As already mentioned, drowsiness is a common side effect of antiepileptic drugs (particularly phenobarbital and Mysoline), and many epileptic

children are considered by their parents and teachers to be more drowsy than their peers (Gadow, 1977b, 1978a; Pietsch, 1977). Although in some cases drowsiness is self induced as a manipulative device, others are truly sedated and are occasionally reprimanded by poorly informed school personnel for laziness. Obviously, a sedated, sleepy child will have greater difficulty performing school activities. If a child does not develop a tolerance for the drowsiness within a couple of weeks after the onset of treatment, the physician can lower the dosage, administer a stimulant (Ritalin or Dexedrine), or substitute another drug for the offending agent (Livingston, 1972). If the same dosage that controls seizures also produces sedation, a difficult risk-to-benefit decision will have to be made.

> Some patients may be better off leading a normal life between occasional seizures than living seizure-free in a perpetual state of drug-induced drowsiness and confusion. Both the physician and patient must decide which is the greater handicap—the drowsiness or the recurrence of seizures. (p. 356)

Another side effect of antiepileptic medication (particularly phenobarbital) that can seriously impair school performance is drug induced behavior disorders, usually hyperactivity. Ways in which the physician can manage this reaction have already been mentioned. There is also another type of behavior disturbance that has not received much attention (Livingston, 1976). Some behaviorally normal children become profoundly restless, hyperactive, belligerent, and exhibit frequent temper outbursts on medication, *regardless of the type of drug*. When medication is stopped or the dosage reduced to the point where seizures reappear, the child's behavior returns to normal. In many cases, the behavior disorder is a greater problem than the seizures. "In such cases it is probably best to allow the child to have an occasional seizure and normal interictal (between seizures) behavior than to be completely seizure free but with uncontrolled behavior" (p. 259).

There are only a few systematic investigations of the relationship between high doses or toxic levels of anticonvulsant drugs and cognitive performance (Stores, 1975). In one study, Dekaban and Lehman (1975) tested 15 epileptic patients on a number of laboratory tests. Each was receiving one or more of the following agents: phenobarbital, Mysoline, or Dilantin. Among the tasks were a vigilance test (similar to the continuous performance test described in Chapter 2) and a reaction time test (pressing a button when a light flashed on). Both are paced by the experimenter and require sustained attention. Each patient was tested at the beginning of the study and on two more occasions after a 30 to 50% change in dosage. The majority performed best on both the vigilance and reaction time tests while on the lowest dose of medication. Eight of the patients felt better subjectively on the lower dose, six could not tell the difference between doses, and one felt better on the highest dose. Dekaban and Lehman noted that heavy medication can impair cognitive performance without there being any clear outward signs of intoxication (e.g., ataxia, diplopia, nystagmus).

Mathews and Harley (1975) compared the performance of two groups of epileptic patients on a number of cognitive and perceptual-motor tests. One group had blood levels of antiepileptic drugs in the low toxic range, and the other had nontoxic blood levels. All patients were receiving one or more of the following drugs: phenobarbital, Mysoline, or Dilantin. The most marked differences between the two groups were on measures of sustained concentration, attention span, motor coordination, and motor steadiness with the nontoxic group performing superior to the toxic group.

Memory processes may also be impaired by high therapeutic doses of barbiturates. MacLeod, Dekaban, and Hunt (1978) compared the performance of epileptic patients receiving a medium and high dose of phenobarbital on short and long term memory tasks. The short term memory task consisted of presenting a series of one to six numbers on a visual display. After a brief pause, a probe number was presented. The patient had to indicate by pressing a lever whether the probe number appeared in the previous display. (There are a number of similarities between this and the short term memory task described in Chapter 2). MacLeod et. al. found (relative to a control group) that the high therapeutic dose of phenobarbital impaired short term memory by increasing the time it took for patients to press the lever. There were no dosage differences on the long term memory task. These results may have implications for school performance because "impairment of short-term memory may critically

influence a person's ability to maintain attention, a crucial ability when one is trying to acquire new information" (p. 1104).

There are also a few reports of anticonvulsant drugs causing general mental slowing and retardation. Cordes (1973) described a case study of a preschool girl who developed mild mental retardation on antiepileptic medication. Termination of treatment was followed by a marked developmental spurt. About another preschool child receiving multiple drugs for minor motor seizures, a mother commented, "Each time he comes off another pill learning increases and the school has less problems" (Gadow, 1977b, p. 46).

For some children, impairment of cognitive performance will be a necessary price that has to be paid for adequate seizure control. However, in certain treatment populations, special efforts must be made to prevent unnecessary overmedication. For example, a strong argument can be made for the necessity to improve existing drug monitoring procedures for mentally retarded epileptic children and adults (Herberg, 1977; O'Neill, et al., 1977; Schain, 1975; Sprague, 1977b). One of the anticipated consequences of such efforts would be a reduction in the number of mentally retarded individuals made more intellectually impaired by their medication. Preschoolers constitute another group that requires special attention (Cordes, 1973; Dekaban & Lehman, 1975; Gadow, 1977b). Because development progresses at such a rapid rate during early childhood, parents, teacher, and physician must seriously consider whether drug induced mental impairment is a reasonable risk for adequate seizure control. It must be reemphasized that the physical (through injury) and psychological consequences of uncontrolled seizures can contribute to severe adjustment problems.

Unfortunately, there are no standard procedures for assessing possible impairment of cognitive performance by antiepileptic medication (MacLeod, Dekaban, & Hunt, 1978). It is imperative, therefore, that school input be an integral part of the drug evaluation procedure, both at the onset of treatment and during alterations in the drug regimen (Gadow, 1978a). It is hoped that future research efforts will provide more information about what to date has been a much neglected topic—the behavioral side effects of anticonvulsant drugs.

PATTERN OF TREATMENT

Drug therapy should be initiated as soon as the diagnosis of epilepsy is made (Livingston, 1978a). In general, the longer the seizures go untreated, the more difficult they are to control. It is as if the brain gets into the habit of having convulsions. Drug treatment should be initiated not only to control seizures, but also to prevent seizure related injuries, brain damage resulting from status epilepticus, emotional disorders, and adjustment problems such as the loss of a job, revocation or denial of a driver's license, and undesirability as a marriage partner.

Whether or not medication should be initiated after only one seizure of unknown cause is controversial. Livingston (1958) reported a study of 200 children who had only a single epileptic seizure prior to diagnosis. Children were randomly assigned to one of two groups: continuous phenobarbital therapy or no medication. There was a dramatic decrease in subsequent seizures for the drug treated group compared to children who were not placed on medication. Livingston's (1978a) position on this issue, presumably based in part on the above study, was as follows:

> We assign the diagnosis of epilepsy to patients who have an unquestionable convulsion of undetermined cause, and we continue with this diagnosis unless the seizure later proves to have been a manifestation of some other disorder. Our general policy is to prescribe daily antiepileptic medication for these patients . . . It is emphasized, however, that a positive diagnosis of major motor epilepsy, for example, should not be made at the time of the initial "attack" in a person whose episode was not clearly defined by the observer as a true convulsion unless the EEG reveals abnormalities such as are seen in patients with grand mal epilepsy. (p. 301)

There is much controversy as to whether Dilantin and phenobarbital should be administered in a single dose once a day or in divided doses throughout the day. After reviewing the literature, Livingston (1978a) concluded that Dilantin and phenobarbital should be administered to both children and adults at least twice daily because divided doses produce a more even blood level during the day. He further stated that if either of these drugs must be given only once a day, ap-

propriate blood level studies should be conducted. Interviews with parents indicate that almost all children with convulsive disorders receive medication in divided doses two or three times per day (Gadow, 1977a, 1978c).

Another characteristic of anticonvulsant drug treatment is the use of two or more drugs for seizure control. The prevalence of polypharmacy ranges from 50% in preschool special education children (Gadow, 1977a) and 53% in trainable mentally retarded children (Gadow, 1978b), to 71% in epileptic children surveyed by the National Epilepsy League (Pietsch, 1977). The most common drug combinations are Dilantin and a barbiturate (phenobarbital or Mebaral), Dilantin and Mysoline, and Mysoline and phenobarbital (Gadow, 1977a, 1978c). The benzodiazepines, succinimides, and oxazoladinediones are rarely used singly. Clinicians have questioned the necessity of *all* these drug combinations and point out that much polypharmacy can be avoided by monitoring drug blood levels (Shorvon & Rey-

TABLE 3-4

Average dosages of antiepileptic drugs*

Drug	Age (Years)	Starting Dosage		Maximal Dosage	
		Mg	Times/Day	Mg	Times/Day
ACTH and Corticosteroids[1]					
Atabrine	Under 6	50	1	50	3
(Quinacrine)	Over 6	50	2	100	3
Bromide	Under 3	160	2	320	3
	3 to 6	320	2	640	3
	Over 6	320	3	1000	3
Celontin[2]	Under 6	150	3	300	4
(Methsuximide)	Over 6	300	2	600	4
Clonopin[3]					
(Clonazepam)					
Depakene[5]					
(Valproic Acid)					
Dexedrine	Under 6	2.5	1	2.5	3
(Dextroamphetamine)	Over 6	2.5	2	7.5	3
Diamox	Under 6	125	3	250	3
(Acetazolamide)	Over 6	250	2	250	4
Dilantin[4]	Under 2	15	3	30	3
(Phenytoin)	2 to 4	30	2	50	4
	4 to 6	30	3	100	3
	Over 6	100	2	100	4
Gemonil	Under 6	50	3	100	3
(Metharbital)	Over 6	100	3	200	3
Mebaral	Under 2	32	3	50	4
(Mephobarbital)	2 to 4	32	4	82	3
	4 to 6	50	4	100	3
	Over 6	100	3	200	3
Mesantoin[2]	Under 6	50	3	200	3
(Mephenytoin)	Over 6	100	3	400	3
Milontin[2]	Under 6	250	2	500	3
(Phensuximide)	Over 6	500	2	1000	4
Mysoline	Under 2	25	2	50	4
(Primidone)	2 to 4	50	3	125	4
	4 to 6	125	3	250	4
	Over 6	250	3	500	4
Paradione	Under 6	150	2	300	3
(Paramethadione)	Over 6	300	2	600	3

Continued on next page

TABLE 3-4—Continued

Average dosages of antiepileptic drugs*

Drug	Age (Years)	Starting Dosage		Maximal Dosage	
		Mg	Times/Day	Mg	Times/Day
Peganone[2]	Under 6	250	3	750	4
(Ethotoin)	Over 6	500	3	1000	4
Phenobarbital	Under 2	16	3	32	3
	2 to 4	16	4	32	4
	4 to 6	32	3	48	3
	Over 6	32	4	65	3
Phenurone[2]	Under 6	250	3	1000	3
(Phenacemide)	Over 6	500	3	2000	3
Tegretol	Under 6	100	1	100	3
(Carbamazepine)	6 to 12	100	2	100	4
	Over 12	100	3	200	5
Tridione	Under 6	150	2	300	3
(Trimethadione)	Over 6	300	2	600	3
Valium[6,7]					
(Diazepam)					
Zarontin	Under 6	250	2	250	4
(Ethosuximide)	Over 6	250	3	500	4

Note. Modified from Livingston, S. *Comprehensive management of epilepsy in infancy, childhood and adolescence,* 1972. Reprinted courtesy of Charles C Thomas, Publisher, Springfield, Illinois.

* This Table includes only the antiepileptic drugs used at the Samuel Livingston Epilepsy Diagnostic and Treatment Center.

[1] The patient should receive a daily intramuscular injection of 20 units of corticotropin twice daily for 4 to 6 weeks, depending upon seizure response. If complete control of seizures and normalization of the EEG are obtained, no further therapy is indicated unless there is a recurrence of clinical seizures. If, after 6 weeks of treatment with ACTH, clinical control of seizures is attained but the EEG remains abnormal, steroid therapy (cortisone or prednisone) should be instituted and continued for a prolonged period in an attempt to normalize the EEG. If there is no clinical response to 6 weeks of ACTH therapy, the patient may be given a trial of oral steroid therapy, administered daily for at least 2 months. It is important that oral steroid therapy be discontinued gradually.

[2] The maximal dosages of these drugs for children over age 6 exceeds the manufacturers' recommendations.

[3] Therapy in younger children is initiated with a daily dose of 0.5 mg and increased by increments of 0.25 to 0.5 mg every 3 to 4 days to a maximum daily dosage of 3 mg. In the older child, 1 mg daily is prescribed initially and increased by 0.5 mg to 1 mg every 3 or 4 days to a maximum daily dosage of 6 mg. In adults, 1.5 mg is prescribed initially and increased by increments of 0.5 to 1 mg every 3 or 4 days to a maximum daily dosage of 20 mg.

[4] We only rarely prescribe phenytoin for infants.

[5] Therapy is instituted with a dose of 15 mg/kg/day and this dosage is continued for 2 weeks. If necessary, the dose is subsequently increased as indicated by clinical response or signs of toxicity by 5 to 10 mg/kg/day each week to a maximum of 50 mg/kg/day. The maximum daily dose recommended in the package insert is 30 mg/kg/day.

[6] Effective dosage of diazepam varies from patient to patient. We start treatment as follows: children under age one, 1 mg every 3 hours for 5 doses daily; young children 2 mg every 3 hours for 5 doses daily; older cildren, 5 mg. every 3 hours for 5 doses daily. The daily dose is increased if necessary, by one dosage per week, depending on clinical response and tolerance to the drug. The appearance of marked drowsiness indicates that the maximal tolerable dosage has been surpassed. The maximal daily dosages we have employed: children under age one, 15 mg.; young children, 30 mg; older children, 50 mg.

[7] The package insert states that oral diazepam is contraindicated in children under age 6 months and that intravenous diazepam is contraindicated in infants under 30 days of age.

nolds, 1977). The usefulness of combining more than three different anticonvulsants has also been questioned (Livingston, 1972; Wilson, 1969), but it is easy to see how such a situation could develop for a child whose seizures remain uncontrolled.

The average dosages for antiepileptic drugs used at the Samuel Livingston Epilepsy Diagnostic and Treatment Center are listed in Table 3–4. It must be emphasized these are *average* dosages, and that the actual dose of medication necessary to achieve satisfactory seizure control varies considerably from patient to patient. This is due, in part, to large individual differences in the rate of drug metabolism and removal from the body. The same dose of Dilantin, for example, produces a wide range of blood levels in people with epilepsy (Lascelles, Kocen, & Reynolds, 1970). Therefore, whereas one person becomes seizure free on 200 mg per day of Dilantin, another may require 600 mg daily for adequate seizure control.

Parents and teachers should be aware of the fact that the effect of a particular dose of Dilantin or phenobarbital cannot be adequately evaluated until a stable blood level is reached (Livingston, 1978b). When medication is given orally on a daily basis, the drug gradually accumulates in the blood and eventually levels off. This process may take from 1 to 2 weeks for Dilantin and from 3 to 4 weeks for phenobarbital in adults. A stable blood level of phenobarbital is achieved sooner in children than adults. It is also recommended that dosage changes should not be made until the blood level of the drug stabilizes.

Because each of the epilepsies responds best to certain drugs, the extent to which individual antiepileptic agents are used is determined, in part, by the prevalence of the different forms of epilepsy. Therefore, the major motor (grand mal) drugs would be expected to be used frequently, and the antipetit mal agents much less often. Surveys of drug use patterns among children treated for convulsive disorders reveal such a distribution (see Table 3–5). It can be seen that by far the most commonly used antiepileptic agents are Dilantin, phenobarbital, and Mysoline. Collectively, they account for three-fourths of the total number of drugs used for seizure control among young and mentally retarded children in special education programs (Gadow, 1976, 1978a). Comparative information about epileptic children in nonspecial education classrooms is not available, but there is no reason to believe that signficiant differences do exist. Because the collection of these data from special education programs either precedes or overlaps the release of Tegretol, Clonopin, and Depakene, these drugs are probably more widely used than indicated in Table 3–5.

Followup studies that investigated the termination of medication show that as compared to adults, the prognosis is much better for children who have become seizure free. After reviewing the limited data available about the withdrawal of antiepileptic drugs, Holowach, Thurston, and O'Leary (1972) reported the relapse rate for seizures ranged from 21 to 28% in three studies on children and from 40 to 46% in three studies that primarily included adults. In their own study of 148 cases of childhood convulsive disorders, they reported the prognosis for grand mal seizures was more favorable than for other types of epilepsy. The highest relapse rates were for children with Jacksonian seizures (53%), mixed seizures (40%), and psychomotor seizures (25%).

TABLE 3–5

Drugs reportedly used in the management of convulsive disorders with children in special education programs*

Generic Name	Trade Name	Trainable Mentally Retarded (children = 332)		Early Childhood Special Education (children = 140)	
		F	%	F	%
Phenytoin	Dilantin	186	56.0	59	42.1
Phenobarbital		166	50.0	76	54.3
Primidone	Mysoline	62	18.7	19	13.6
Carbamazepine	Tegretol	26	7.8	3	2.1
Acetazolamide	Diamox	22	6.6	3	2.1
Ethosuximide	Zarontin	22	6.6	2	1.4
Clonazepam	Clonopin[2]	19	5.7	0	0.0
Diazepam	Valium	18	5.4	11	7.9
Mephobarbital	Mebaral	13	3.9	7	5.0
Methsuximide	Celontin	7	2.1	3	2.1
Other		28	8.4	22	15.7
Total[1]		569	171.2	205	146.3

* Data about trainable mentally retarded children are from Gadow (1978a), and data about early childhood special education children are from Gadow (1977b).

[1] Totals are inflated because 177 of the mentally retarded children and 50 of the preschool children received more than one antiepileptic drug during the school year.

[2] Recently approved by the Food and Drug Administration for use in the management of convulsive disorders when the data were collected (in 1975) about the early childhood sample.

Only one of the eight children with petit mal spells, all of whom received phenobarbital as a prophylactic measure to prevent grand mal, had a relapse. If seizures have an organic cause and the child is mentally or motorically retarded, the probability of seizure relapse during drug withdrawal is greatly increased. The prognosis is best for seizures that have an early onset and are quickly controlled compared to seizures originating during infancy or later childhood, and which are difficult to bring under control. In general, the longer a person is on medication and seizure free, the less likely there will be a relapse after drug therapy is withdrawn. With the exception of petit mal spells, the EEG is of little value in the decision to withdraw drug therapy.

A general rule for the discontinuation of drug treatment for convulsive disorders is to wait at least 4 years after the last seizure before considering the termination of medication (Livingston, 1972, 1978b). An additional 1 to 4 years may be required for dosage reduction and gradual drug withdrawal, depending upon the initial dosage and severity of seizures. Sudden discontinuation of medication may precipitate seizures and possibly grand mal status. Occasionally, it is more difficult to control a recurrence of seizures after a sudden withdrawal of medication with the same regimen that was previously effective. The actual seizure free period may be less than 4 years if the anticonvulsant drugs are producing serious side effects or impairing performance. Also, the stigma of taking medication may be difficult to live with, especially for teenagers. If the seizure free period overlaps the onset of puberty, it may be judicious to continue medication throughout adolescence. This is particularly relevant for females. When the first seizure occurs in late adolescence or early adulthood, it is quite likely that medication will have to be continued throughout the person's lifetime. If seizures occur during the period when the dosage of medication is being reduced, continuous lifetime treatment also is very probable.

Anticonvulsant Blood Levels

The development of procedures for analyzing the amount of anticonvulsant drugs in the blood has had a marked effect on the ability to monitor certain aspects of treatment. Although there is quite a bit of variation from child to child and the amount of drug in the blood necessary for seizure control, there is a good relationship between blood level and signs of intoxication. For example, Kutt (1974) reported that blood levels from 10 to 40 μg/ml are considered in the effective treatment range for phenobarbital. Generally speaking, blood levels below 10 μg/ml are not effective in seizure control, and levels above 40 μg/ml produce adverse reactions. Similar guidelines are available for Dilantin, but for most other anticonvulsants, much has yet to be learned about blood level and toxicity (Livingston, 1978b).

There are several situations in which determining the amount of drug in the blood can be quite helpful (Livingston, 1978b). Perhaps the most important is when it is necessary to see if the child is actually taking medication as prescribed. If there is an increase in seizure frequency, a blood level analysis can help determine whether the drug is not controlling the seizures or the child is not taking (swallowing) the medication. If medication was administered as prescribed, a low blood level would indicate that the dosage should be increased. A second indication for monitoring blood level is when signs of intoxication appear at low doses and precise adjustments have to be made. A third situation is identifying which agent is producing intoxication in a multiple drug regimen. Blood analysis can determine whether one drug is raising or lowering the blood level of another drug. A final indication for using blood monitoring procedures is in the treatment of children who cannot verbally report how the drug is affecting them (e.g., severely retarded individuals) or who exhibit behaviors similar to intoxication (e.g., young children learning to walk may appear ataxic).

DRUG INTERACTIONS

Antiepileptic drugs may interact with one another, with psychotropic drugs, or with a variety of other medicines. When one considers the extent of polypharmacy in epilepsy, it would not be unusual to occasionally encounter such reactions in children.

With anticonvulsant drugs, many of the key interactions take place at the metabolic level. An agent that stimulates or inhibits the metabolism of an anticonvulsant will alter the level of the antiepileptic drug in the blood. An example may help clarify this relationship. The liver breaks down Mysoline into phenobarbital and phenylethylmalonamide. At this writing, it is believed that the phenobarbital accounts for the anticonvulsant properties of Mysoline. If a child is taking Mysoline but his or her seizures are still uncontrolled, the physician may add another drug, for

example, Dilantin. The Dilantin, however, could stimulate the metabolism of Mysoline, resulting in higher levels of phenobarbital in the blood (Callaghan, Feely, Duggan, O'Callaghan, & Seldrup, 1977). The increased blood level of phenobarbital *may* result in either better seizure control or noxious side effects.

All the major anticonvulsants (phenobarbital, Mysoline, Dilantin, and Tegretol) are powerful stimulators of liver metabolic processes (Richens, 1975). Space limitations do not permit a detailed discussion of all the possible interactions of clinical significance. However, in order to provide an appreciation for the complexity of these reactions, another example will be given.

Many drugs can inhibit the metabolism of Dilantin (Kutt, 1974). When the rate at which Dilantin is broken down into inactive metabolites is slowed down, the level of the active drug in the blood increases. This could result in greater seizure control if the child is still having attacks, Dilantin intoxication, or both. It is noteworthy that if the blood level of Dilantin gets too high, the drug may provoke a seizure or *increase* the frequency of attacks (Levy & Fenichel, 1965). The reader who wishes additional information about drug interactions with antiepileptic agents should consult other authoritative sources such as Hooshmand (1974), Kutt and Louis (1974), Pippenger, Siris, Werner, and Masland (1975), Richens (1975), and Woodbury, Penry, and Schmidt (1972).

The way in which drug interactions are managed probably varies with the clinician. Shorvon and Reynolds (1977) argued that much unnecessary polypharmacy might be the result of one drug simply elevating another drug to effective levels in the blood. If this were the case, the best thing to do would be to increase the dosage of the effective drug and withdraw the drug that caused the interaction. Unfortunately, things are not always that simple. Both drugs may be required for treatment if one really is not completely effective or if the drugs are being used to control two different types of disorders. In such cases, the dosage of one drug may have to be raised or lowered depending upon the situation. The child and family may be so alarmed by the effects of the drug interaction that the parents terminate the most recently added (presumably offending) agent. It must be emphasized that although antiepileptic drug interactions are possible, they only affect a *small* percentage of patients who receive multiple drugs in such a way that dosage reduction or withdrawal of medication must be employed.

NATIONAL ORGANIZATIONS

Epilepsy Foundation of America
Suite 406
1828 L Street, N.W.
Washington, D.C. 20036
202/293–2930

Epilepsy Foundation of America
(Formerly National Epilepsy League)
6 North Michigan Avenue
Chicago, Illinois 60602
312/332–6888

The Epilepsy Foundation of America (EFA) is a major national agency for people with epilepsy sponsoring a wide variety of programs and activities. The Foundation provides information on epilepsy and its consequences to any person or group requesting it. Areas include:

1. Information on epilepsy for the patient, his family, and friends.
2. Educational materials to individuals and groups dealing with people with seizure disorders.
3. Information on employment, including vocational rehabilitation and training, rights, hiring and insurance regulations, special programs, and the particular employment needs of some people with epilepsy whose seizures are not fully controlled.
4. Specific information on the rights of persons with epilepsy as guaranteed by federal and state statutes.
5. Housing information (mostly about discrimination and alternative living arrangements, such as group homes).
6. Transportation information, including federal and state driving regulations.
7. Health services information, including prevention, diagnosis, treatment, rehabilitation, and maintenance.
8. Information on economic, social, and psychological services, such as disability benefits and supplemental security income, recreational services, and individual and group counseling programs as they might apply to persons with epilepsy and their families.
9. Information on the latest research into the causes, treatment, and prevention of seizures.

10. Information on federal and state programs that affect people with epilepsy.

Antiepileptic drugs can be very expensive. In order to alleviate the burden placed upon families by the cost of these drugs, the Epilepsy Foundation of America (Chicago office) has for years maintained a Cooperative Pharmacy Service. All of the drugs and medicines prescribed in the treatment of epilepsy are available to any epilepsy patient below retail costs. Contact the Chicago office for more information about this service.

SUGGESTED READINGS

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4/Mental Retardation

Drug treatment with mentally retarded children and adults is considered a separate topic in this book for several reasons. First, many of the disorders for which psychotropic and antiepileptic drugs are prescribed are prevalent among retarded populations. This is particularly true for the more severely and profoundly impaired individuals. Second, it is often unclear as to whether some disorders associated with mental retardation are the same, both in terms of etiology and response to treatment, as apparently similar disorders (e.g., hyperactivity) in nonretarded individuals (Fish, 1971). Third, some drug treated disorders, such as stereotyped behavior, are commonly associated with mental retardation. Fourth, because several different types of disorders are frequently found in a given retarded child, the prevalence of combined drug regimens is also greater. For example, a mentally retarded child may be treated simultaneously for epilepsy, cerebral palsy, and behavior disorders. Associated with combined drug regimens, of course, is the potential problem of drug interaction. And finally, the way in which social agencies and the general population respond to retarded people may interact in a complex fashion with decisions about drug treatment. For example, the recent emphasis on deinstitutionalization is bringing many severely and profoundly retarded persons into the mainstream of everyday life through community placements. The feasibility of such placements for some individuals with severe behavior problems *may* depend upon effective pharmacotherapy.

It should be noted that psychotropic drugs are not prescribed for mental retardation per se. The objective of drug treatment is not to "cure" or change biochemical processes in such a fashion that a mentally retarded child can perform like his or her nonretarded peers. Although medication may improve learning and cognitive performance, the typical reason for prescribing medication is the control of behavior disorders, notably hyperactivity, aggressivity, self injurious acts, and stereotyped motor movements.

DISORDERS ASSOCIATED WITH MENTAL RETARDATION

The prevalence of behavior problems is much higher among mentally retarded children as compared to their nonretarded age mates. A study of 9 to 11 year old British children on the Isle of Wight showed that this relationship holds up whether the source of information is behavioral ratings obtained from parents or teachers or psychiatric examinations (Rutter, 1971; Rutter, Tizard, & Whitmore, 1970).

Payne, Johnson, and Abelson (1969) conducted what must certainly be one of the most comprehensive surveys of mentally retarded persons in residential facilities. Twenty-two institutions in the Western United States were asked to provide detailed data on a total of 24,257 residents in 1968. Ward personnel made behavioral ratings using a four-point scale: never, seldom, occasionally, and frequently. Of primary interest were behaviors considered maladaptive

(i.e., those that interfered with institutional programing). The most common behaviors rated "frequently" were hyperactivity, aggressivity, and running. Other "frequent" behaviors were self destructiveness, requiring restraints, destroying clothing, and attacking other residents. Of the residents, 21% were characterized as "occasionally" hyperactive and/or aggressive.

Eyman and Call (1977) studied the prevalence of maladaptive behavior in mentally retarded individuals living in residential facilities, community settings, or their own homes. Using a behavior rating scale, social workers in community settings and direct care personnel in institutions evaluated 6,870 mentally retarded children and adults. Clients were divided into three groups according to level of retardation: profound, severe, and mild-moderate. Group comparisons revealed a greater frequency of behavior problems in profoundly retarded as compared to mild-moderately retarded persons. The prevalence of behavior disorders was also much higher in institutions than in community settings. Three behavior problems were quite common, with some variation across age and level of retardation: stereotyped behavior, hyperactivity, and aggressivity. The latter was subdivided into violence toward others, violence toward oneself or self injurious behavior, and the destruction of property.

Approximately half of the individuals under 13 years of age in institutions had stereotypies (repetitive, often bizarre motor activity). In general, the figures were lower for those in community placements and for older, moderately retarded residents. Examples of such behavior are rhythmic rocking, head weaving, mouthing, hand or arm flapping, and rubbing parts of the body.

As with hyperactivity and behavior problems, the prevalence of convulsive disorders among moderate to profoundly retarded people is greater than among the general population. Schain (1975) described the relationship between the two disorders as "linked together epidemiologically, etiologically, clinically and therapeutically." Although convulsive disorders do not appear to be more prevalent among borderline and mildly retarded individuals than in the general population (Slater & Cowie, 1971), estimates for severely and profoundly retarded persons in residential facilities are as high as 30% (Jasper, Ward, & Pope, 1969).

Another disorder associated with mental retardation is cerebral palsy, which may also be treated with psychotropic drugs. Valium (diazepam) and Dantrium (dantrolene sodium), the most frequently prescribed skeletal muscle relaxants used in the management of cerebral palsy, are discussed in greater detail in the next chapter.

PREVALENCE AND PATTERN OF DRUG TREATMENT IN RESIDENTIAL FACILITIES

Lipman (1970) conducted a questionnaire survey on psychotropic drug use in state and private institutions for the mentally retarded. Findings revealed that the extent of drug use was considerable, and that 51% of the residents had received psychotropic agents at some time. Two major tranquilizers, Mellaril (thioridazine) and Thorazine (chlorpromazine), accounted for over half of all reported drugs, and they were the preferred agents in 91% of the institutions. Some of the reported maximum dosages were quite high: 3,000 mg/day for Thorazine and 1,800 mg/day for Mellaril (see Table 4-1). Even more disturbing was the chronic nature of drug use: 25% of the drug treated residents had received medication for 4 or more years.

Recently, Sprague (1977a) reported data about the extent and pattern of psychotropic and antiepileptic drug treatment from the records of retarded residents in two midwestern facilities, one old and one new (see Table 4-1). The older institution housed 1,639 residents in buildings with day rooms and open wards. Residents ranged from moderately to profoundly retarded, with a mean age of 27.4 years. The new (small) facility housed 286 residents who lived in group homes each designed for eight people. The entire facility was modeled after community living; and from outward appearances, it looked much like a suburban housing division. Residents ranged from moderate to profoundly retarded with a mean age of 29.4 years. Despite differences in the philosophy and type of care represented by these two facilities, the prevalence of drug treatment was quite similar: 66% in the older large institution and 65% in the new community styled facility. Over half the residents on medication in both facilities were receiving two or more psychotropic and/or antiepileptic drugs. The three most frequently reported drugs in both institutions in rank order were Mellaril, Dilantin (phenytoin), and phenobarbital.

Although there is an emerging picture of the extent and pattern of drug treatment with mentally retarded individuals in residential facilities,

TABLE 4-1

Drug survey results from two midwestern institutions for mentally retarded individuals

Rank	Drug	*N*	Daily mg dose Mg/kg		Months administered	Weight (Kg)	Number of other drugs	Number of daily administrations
			Large institution ($N=1,100$)					
1	Mellaril (thioridazine)	477 (43.4%)	Mean 229.8 Median 175 Range 10–1200	Mean 4.12 Median 3.07 Range .36–18.12	30.9	55.97	1.1	2.2
2	Dilantin (phenytoin)	437 (39.7%)	Mean 177.2 Median 180 Range 30–400	Mean 3.88 Median 3.70 Range .44–18.38	50.0	49.21	1.8	2.4
3	Phenobarbital	422 (38.4%)	Mean 112.2 Median 95 Range 15–400	Mean 2.49 Median 2.04 Range .37–15.27	39.2	49.62	1.8	2.2
4	Thorazine (chlorpromazine)	92 (8.4%)	Mean 296.2 Median 250 Range 25–1200	Mean 5.00 Median 4.49 Range .59–20.79	22.6	59.48	2.1	2.7
5	Valium (diazepam)	89 (8.1%)	Mean 12.4 Median 10 Range 2–40	Mean .30 Median .24 Range .05–.96	38.0	43.13	1.3	2.7
			Small institution ($N=187$)					
1	Mellaril (thioridazine)	97 (51.9%)	Mean 206.2 Median 300 Range 25–600	Mean 3.20 Median 2.76 Range .54–10.67	6.9	65.79	1.0	2.5
2	Dilantin (phenytoin)	61 (32.6%)	Mean 217.7 Median 300 Range 50–400	Mean 3.50 Median 3.56 Range .69–8.24	7.7	64.21	1.9	2.3
3	Phenobarbital	53 (28.3%)	Mean 117.5 Median 120 Range 30–300	Mean 1.80 Median 1.70 Range .38–4.56	8.0	64.65	1.9	2.0
15	Thorazine (chlorpromazine)	3 (1.6%)	325.0	3.96	3.0	70.41	1.3	2.7

Note. From Sprague, R. L. Overview of psychopharmacology for the retarded in the United States. In P. Mittler (Ed.), *Research to practice in mental retardation* (Vol. 3). Baltimore: University Park Press, 1977, p. 201. Copyright 1977 by the International Association for the Scientific Study of Mental Deficiency. Reprinted by permission.

very little has been reported about the exact reason these drugs are prescribed. Klebanoff, DiMascio, and Lowe (1973) reported on one attempt to determine why these drugs are prescribed by surveying 33 staff physicians working in state institutions in Massachusetts. They reported that Mellaril and Thorazine were prescribed primarily for the control of agitated and/or aggressive behavior and of psychotic states. However, drug use for the control of agitation/aggression was reported twice as often as for psychosis. The primary reasons for prescribing Valium were for epilepsy and as a muscle relaxant for cerebral palsy. Phenobarbital was used primarily as an anticonvulsant and secondarily to induce sleep.

In another study on reasons for drug use in mental retardation, Sewell and Werry (1976) surveyed the records of 648 residents (mean age 22 years) in a facility in New Zealand. They found psychotropic drugs were actively being administered to 40% of the residents in this facility, with major tranquilizers being prescribed to 61% of those on medication. Thorazine and Mellaril were the most frequently prescribed drugs. The target symptoms for which the major tranquilizers were prescribed, in rank order of frequency, were hyperactivity, noisiness, aggressiveness, destructiveness, self mutilation, and perverseness. Polypharmacy was quite common: 60% of the residents received two or more psychotropic drugs, and 20% received three or more.

The extent and pattern of drug treatment for convulsive disorders with mentally retarded residents is even less well documented than for behavior disorders. However, anticonvulsant medication, particularly Dilantin, phenobarbital, Mysoline (primidone), and Valium, are among the most frequently prescribed drugs in residential facilities (Sprague, 1977a). Payne et al. (1969) reported that 26% of all the mentally retarded persons in the institutions they surveyed were receiving drugs for seizure control. Institutions with the greater proportions of severe and profound residents reported the most extensive use of drugs to control seizures.

A survey was conducted among the 3,000 residents of an institution in Virginia to identify epileptics as part of a program to improve health care services (O'Neill, Ladon, Harris, Riley, & Dreifuss, 1977). The residents were primarily adults, had been hospitalized for long periods of time, and were functioning at the severely to profoundly retarded level. Approximately 30% were receiving antiepileptic drugs. Patients were grouped according to three categories of seizure control: controlled—no seizures for a year, partially controlled—one to three seizures in any quarter of the year, and uncontrolled—four or more seizures in any quarter of the year. Using this criterion, 13% were classified as uncontrolled, 24% as partially controlled, and 63% as controlled. The identity of specific drugs was not reported, however, the investigators noted that polypharmacy was "commonplace."

PREVALENCE AND PATTERN OF DRUG TREATMENT IN PUBLIC SCHOOLS

From a comprehensive survey of public institutions, private facilities, and state mental hospitals conducted in 1969 by the Office of Mental Retardation Coordination (1972), it was determined that 255,000 mentally retarded children and adults were in residential facilities. Although surveys of records from institutions tell us a great deal about drug treatment with the severely and profoundly retarded residents, this population accounts for a small part of the estimated 2 to 6 million retarded persons in the United States (Robinson & Robinson, 1976).

Data on the number of mentally retarded children in public schools are becoming available as a result of requirements established in the Education for All Handicapped Children Act (P.L. 94-142) by which special education programs may receive federal support. In February 1977, a total of 3,618,410 children were reported receiving special education services in public school (Division of Innovation and Development, Bureau of Education for the Handicapped, 1977). Of these children, 856,556 were designated as being served in programs for mentally retarded students. Unfortunately, there is no breakdown by degree of impairment (i.e., educable, trainable). This figure is somewhat conservative considering that many exceptional children do not fall neatly into one category. Also, there are probably many mentally retarded children whose needs go unattended. Using the frequently cited 2 to 3% prevalence rate for mental retardation (Robinson & Robinson, 1976), one would expect a larger number of children to be in need of special services. Regardless of the errors in estimating the number of mentally retarded children in public schools, little is known about the extent and pattern of drug treatment with this population.

Trainable Mentally Retarded Students

In general, programs for the trainable mentally retarded (TMR) pupil serve children and adolescents who score between 30/35 and 50/55 on standardized IQ tests. What is known about the pattern and prevalence of drug use among children in these programs comes from one statewide study conducted in Illinois (Gadow, 1978b; 1978c). Teachers in TMR classrooms were mailed questionnaires that requested information about children receiving medication, and many of the parents of these children were interviewed. The children served by these programs ranged in age from 3 to 21 years.

The results of the study showed that of the 3,306 students in the programs surveyed, 18.1% received psychotropic or antiepileptic drugs at some time during the school year. Approximately 10% of these children were receiving medication for the management of convulsive disorders, and 4.9% were receiving medication for behavior disorders. An additional 1.8% of the sample received drugs for both behavior problems and seizures. Psychotropic drugs were also prescribed for other disorders, the most frequent being cerebral palsy, anxiety, and enuresis.

Stimulants and major tranquilizers were the most commonly prescribed drugs for the management of behavior disorders (see Table 4-2). It can be seen that, as a group, stimulants accounted for 45% of the *total* number of psychotropic drugs, and major tranquilizers accounted for 37%. The two most frequently administered drugs were Ritalin and Mellaril. However, almost two dozen different drugs were reportedly used in the management of behavior disorders.

The most common reasons for drug treatment were hyperactivity, behavior problems, and aggressivity. Other reasons for prescribing medication were psychotic behavior and attentional deficits. When asked to list specific behavioral changes as a result of drug therapy, teachers most often reported less motor restlessness (hyperactivity), improved attention to tasks, fewer behavior problems, and greater manageability.

Compared to the prevalence of psychotropic drug treatment in residential facilities, the use of drugs with TMR children is much less frequent. Also, when medication is prescribed for behavior management, the TMR child in school is more apt to receive a stimulant, whereas the institutionalized child will probably be given a major tranquilizer.

From both teacher questionnaires and interviews with parents of TMR children on medication, some generalizations can be made about the pattern of treatment. First, only a small percentage of children are actually placed on medication during the school year. The incidence (number of new cases) of drug treatment for behavior disorders was 6.3 cases per 1,000. This is a far cry from some popular scenarios that depict teachers and doctors in a conspiracy to enslave mentally retarded children in chemical straight jackets. Second, drug treatment often has an early onset and is maintained, sometimes intermittently, for long periods of time. Although differences among age groups in the prevalence of drug treatment were not significant, the trend was for increased use during adolescence. Finally, combined drug regimens were relatively infrequent: only 13% of the behavior disordered children were on more than one drug. Additional drugs were usually prescribed to control the side effects produced by major tranquilizers or to help induce sleep at night. Of the few drug combinations reported, the two most frequent were Ritalin-Mellaril and Tofranil-Mellaril.

The prevalence of drug treatment for convulsive disorders among TMR children was almost twice that for behavior disorders with 11.9% receiving antiepileptic drugs. Dilantin and phenobarbital were the two most frequently administered drugs for the control of seizures, accounting for 62% of all antiepileptic drugs (see Table 3-5). The incidence rate for the onset of drug treatment for epilepsy during the school year was 3.9 new cases per 1,000. Parents reported the onset of treatment was usually quite early, often between birth and 2 years of age. Polypharmacy was common, with over half of the convulsive disordered children receiving more than one drug. Of that group of children, 15% received three or more drugs for seizure control.

Educable Mentally Retarded Students

In general, children who are referred to as educable mentally retarded (EMR) score between 50/55 and 75/80 on standardized IQ tests. As a group, they constitute the largest number of children in categorical special education programs for mentally retarded students. Although recent efforts in mainstreaming have focused on EMR children, many remain in segregated programs for at least part of the school day (Borginsky,

1974). Because teachers in categorical special education programs frequently ask questions about medication in reference to the population of children with which they work, information about drug treatment with different categories of exceptionality have been presented when available. Unfortunately, there are no published reports about the pattern and prevalence of drug use with children or adolescents in EMR programs. Research on drug effects in this population is also limited (Blacklidge & Ekblad, 1971; Sprague & Werry, 1974).

DRUGS USED IN THE MANAGEMENT OF BEHAVIOR DISORDERS

As noted, surveys show that both stimulants and major tranquilizers are frequently prescribed for behavior disorders in mentally retarded children and adolescents. These studies also report that one of the most common reasons for drug use is hyperactivity. Because hyperactivity is a symptom characteristic of at least several different behavior disorders, it would be inappropriate to infer that stimulants are the "drugs of first choice"

TABLE 4-2

Drugs reportedly used in the management of behavior disorders with children in special education programs.[a]

Generic Name	Trade Name	Trainable Mentally Retarded (children = 161) F	%	Early Childhood Special Education (children = 175) F	%
1. *Stimulants*		(90)		(130)	
Methylphenidate hcl	Ritalin	68	42.2	112	64.0
Magnesium pemoline	Cylert	11	6.8	5	2.9
Dextroamphetamine	Dexedrine	9	5.6	11	6.3
Other		2	1.2	2	1.1
2. *Major Tranquilizers*		(68)		(23)	
Thioridazine	Mellaril	40	24.8	19	10.9
Chlorpromazine	Thorazine	12	7.5	2	1.1
Haloperidol	Haldol	6	3.7	1	0.6
Trifluoperazine hcl	Stelazine	5	3.1	0	0.0
Fluphenazine hcl	Prolixin	3	1.9	0	0.0
Other		2	1.2	1	0.6
3. *Minor Tranquilizers*		(12)		(9)	
Diazepam	Valium	7	4.3	4	2.3
Hydroxyzine hcl	Atarax	2	1.2	3	1.7
Chlordiazepoxide hcl	Librium	2	1.2	0	0.0
Hydroxyzine pamoate	Vistaril	1	0.6	2	1.1
4. *Miscellaneous*		(31)		(44)	
Imipramine	Tofranil	9	5.6	6	3.4
Phenobarbital		6	3.7	5	2.9
Phenytoin	Dilantin	3	1.9	20	11.4
Diphenhydramine hcl	Benadryl	2	1.2	5	2.9
Amitriptyline hcl	Elavil	2	1.2	0	0.0
(Fixed Ratio Product)	Phenergan	2	1.2	0	0.0
Other		3	1.9	5	2.9
	Unknown	4	2.5	3	1.7
Total[b]		201	124.5	206	117.7

[a] Data on trainable mentally retarded children are from Gadow (1978a), and data on early childhood special education children are from Gadow (1976).

[b] Totals are inflated because 34 TMR children and 28 preschool children received more than one drug during the school year.

in treating all hyperactive mentally retarded children (Fish, 1971). On the other hand, it is clear that stimulants are used frequently for hyperactivity, behavior problems, and aggressive behavior with mentally retarded children in public schools (Gadow, 1978a). In view of the effects of stimulants in adults (Turner & Carl, 1939; Weiss & Laties, 1962), hyperactive elementary school children (Ross & Ross, 1976; Safer & Allen, 1976), and normal preadolescent boys (Rapoport et al., 1978), it should come as no surprise that mentally retarded children respond to these agents in a way that is perceived as beneficial by parents and teachers. Because the effect of stimulants is described in detail in Chapter 2, only the major tranquilizers are discussed here. No attempt will be made to survey the literature about drug treatment with mentally retarded populations as there are already a number of excellent review articles available (Freeman, 1966, 1970a, 1970b; Lipman, DiMascio, Reatig, & Kirson, 1978; Sprague & Werry, 1971). It is noteworthy that only a few psychotropic drug studies with mentally retarded individuals have been published since Sprague and Werry's (1971) review of the literature through 1970.

The first report of the use of a major tranquilizer (Thorazine) in the treatment of adult psychiatric disorders appeared in 1952. A year later, the first article about the use of Thorazine with children was published. Since then, literally dozens of major tranquilizers have been developed and marketed. A listing of many of these agents appears in Appendix A. Although it would seem that ample time has elapsed to collect a considerable amount of research information about the effects of these agents in children, relatively few studies have actually been conducted (DiMascio, Soltys, & Shader, 1970; Sprague & Werry, 1974). Much of what has been done contains serious methodological flaws and lacks systematic documentation of side effects. In contrast to pediatric research, there is a voluminous literature about the use of major tranquilizers in the treatment of adult psychiatric disorders and information from these studies is referred to when necessary to describe drug effects.

Major tranquilizers are used extensively with mentally retarded children, particularly in residential facilities. Although it would be inappropriate to consider the behavior disorders of mentally retarded persons as identical to psychiatric disorders, there are many similarities between the bizarre behavior of severely and profoundly retarded persons and psychotics. One of the objectives of pharmacotherapy with psychotics is the suppression of maladaptive behavior (i.e., behavior that is injurious to self and others, is socially unacceptable, and interferes with therapeutic progress). It is reasonable to assume that drug therapy for severe behavior problems with mentally retarded children is similarly motivated. However, because of the prevalence of psychotropic drug use in residential facilities, a number of researchers, clinicians, and educators have seriously questioned whether or not the resident's well being is always the overriding concern (Sprague, 1977b, 1978).

The major tranquilizers consist primarily of three subgroups: *phenothiazines* (e.g., Mellaril, Thorazine, Stelazine), *butyrophenones* (e.g., Haldol), and *thioxanthenes* (e.g., Taractan, Navane). The phenothiazines are the most widely used major tranquilizers, and, for this reason, they are the primary focus of the following discussion. There are two more categories of major tranquilizers (see Appendix A), but, at the present, they are used infrequently with mentally retarded individuals. Although there are some marked differences in the prevalence of certain adverse drug reactions, all the major tranquilizers have similar effects on behavior disorders.

DRUG USE WITH ADOLESCENTS AND ADULTS

The major tranquilizers have proven to be effective in the suppression of symptoms associated with certain psychiatric disorders: schizophrenia, manic states, and agitated depression (Honigfeld & Howard, 1973). These drugs can have a pronounced effect on disordered thought, hyperactive behavior, combativeness, and uncooperativeness. Patients who suffer dramatic changes in mood in a relatively short period of time are also aided by these agents because of their mood regularizing effects. Other therapeutic effects in schizophrenics include making patients less withdrawn and more responsive and suppressing hallucinations and delusions. Because many severely and profoundly mentally retarded individuals exhibit behaviors similar to those of people diagnosed as having certain types of psychiatric disorders, it is not unusual that a medical approach to the treatment of mental retardation should draw heavily upon psychiatry.

The general behavioral effects of the phenothiazines in normal adults are "psychomotor slowing, emotional quieting, and affective indifference" (Goodman & Gilman, 1975). To an observer, adults receiving phenothiazines are less active and movement appears slower. They are not upset by situations or events that would normally arouse them, perceiving the world with a detached serenity. Although fully capable of thinking clearly and conversing, they appear indifferent to feelings and express thoughts without emotion. Spontaneous motor activity can be greatly reduced. People taking phenothiazines perform less well on tasks that require sustained attention, and there is a general impairment in cognitive performance and learning at higher dosages (Hartlage, 1965). Initially, Mellaril and Thorazine produce a considerable degree of sedation (drowsiness, lethargy) for which the patient usually develops a tolerance within several days to a few weeks, often without a reduction in dosage.

In addition to their effects on behavior, phenothiazines modify some bodily functions. They can affect the autonomic nervous system, producing a variety of reactions that include blurred vision, contraction of the pupils, decreased sweating and salivation, nasal stuffiness, dizziness, constipation, and inhibition of ejaculation without interfering with erection (Goodman & Gilman, 1975). The latter is particularly true of Mellaril. The endocrine system can also be affected by treatment with the phenothiazines. In particular, changes in the release of *gonadotropic* hormones may cause discharge from the nipples in males and females as well as breast growth. Drug induced changes in the release of growth hormones may account for frequent reports of increased appetite and weight gain.

The primary effect on the cardiovascular system is low blood pressure (*hypotension*) which may cause fainting, particularly if a person rises from a sitting position quickly. *Jaundice* is observed in less than 2 to 4% of the patients treated with Thorazine. This is generally mild and commonly occurs between the second and fourth week of treatment. If jaundice occurs, treatment is usually terminated and another drug is substituted. Skin reactions are fairly common, with *urticaria* or *dermatitis* reported in about 5% of those treated with phenothiazines. This usually occurs within the first to fifth week of treatment—clearing up when medication is discontinued.

Photosensitivity is another type of skin reaction. In some people taking phenothiazines, exposure to the sun results in a severe sunburn. This can be prevented by simply keeping clothed areas well covered and using a sunscreen on skin exposed to sunlight. Long term drug use at high dosages can also produce a gray-blue *pigmentation* in skin areas exposed to the sun.

After reviewing the psychiatric literature, Klein and Davis (1969) classified the frequency of side effects as follows: very frequent—20% or more, frequent—10 to 20%, occasional—5 to 10%. For Mellaril, the very frequent side effects were nausea, vomiting, drowsiness, dizziness, and dry mouth. Frequent adverse effects were visual disturbance and constipation; occasionally, patients were confused or had urinary disturbance. The very frequent side effects of Thorazine were drowsiness, dry mouth, and weight increase. Frequent effects were depression, visual disturbance, and constipation; occasional effects include confusion, allergic reactions, and endocrine disturbances.

Dose and side effect information for frequently prescribed major tranquilizers are presented in Table 4-3. Although the dosage information is in reference to adult psychiatric disorders, listed doses are similar to those employed in residential facilities for mentally retarded people (see Table 4-1). It is interesting to note that a recent survey of children in residential facilities reported that the average dose in mg/kg was higher for children than adults (Cohen, 1978).

EXTRAPYRAMIDAL SYNDROMES

Perhaps the most disquieting and alarming side effects of the major tranquilizers for children, their parents, and caretakers are the *extrapyramidal syndromes*. These are disorders that involve certain motor areas of the brain called the *extrapyramidal tract*. The various *nuclei* (group of nerve cells) and nerve fibers that make up this structure control and coordinate motor activities, especially walking, posture, muscle tone, and patterns of movement. Drugs that affect the extrapyramidal tract can cause spasms in skeletal muscles and changes in body posture, facial expression, and movement of the limbs. There are four different extrapyramidal syndromes frequently associated with the use of major tranquilizers: *parkinsonian syndrome*, *akathisia*, *acute dystonic reactions*, and *tardive dyskinesia*. These side effects are most common in treatment with Haldol, Stelazine, and Compazine

and are least likely to occur with Mellaril (see Table 4-3).

The parkinsonian syndrome caused by the major tranquilizers appears similar to the symptoms of Parkinson's disease. The syndrome is characterized by a decrease in spontaneous movements. The patient appears depressed, with a masklike facial expression which parents and caretakers may refer to as "looking like a zombie." Associated with this is muscle rigidity, changes in posture, and *tremor*. Other features may include drooling, a shuffling walk without free swing of the arms, and "pill-rolling." The latter refers to movements of the hand as if the patient is rolling a pill between his or her fingers. There is disagreement as to the best way of managing this side effect. Some patients may respond to dosage reduction while others may require *anticholinergic* agents, such as Artane (trihexphenidyl) or Cogentin (benztropine). For children, oral doses of 1 mg of Artane three times a day or 1 to 2 mg of Cogentin three times a day rapidly alleviate these symtpoms (Winsberg, Yepes, & Bialer, 1976).

Akathisia refers to involuntary motor restlessness. The patient is unable to sit still, is constantly fidgeting, and appears to be agitated. The disorder responds to dosage reduction as well as to anticholinergic drugs.

Acute dystonic reactions are a third type of extrapyramidal syndrome. Symptoms include one or more of the following: facial grimacing, *oculogyric crisis* (fixed upward gaze), and *torticollis*. The latter refers to a twisting of the neck and an unnatural positioning of the head due to contraction of the neck muscles. The tongue may be protruded or teeth tightly clenched. In rare cases, the patient may have difficulty swallowing. Although this reaction responds well to treatment, it can be terrifying for both patient and caretakers. Acute dystonic reactions are common with Compazine and Stelazine, as compared to the other major tranquilizers. They are more apt to occur in younger patients and when medication is first initiated. A child having a severe reaction should receive immediate medical attention. The physician may use an intramuscular injection of Benadryl or of anticholinergic agents for immediate relief of symptoms, and later prescribe oral doses of Cogentin or Artane for the continued control of this reaction.

The fourth extrapyramidal syndrome, tardive dyskinesia, typically appears late often months after drug treatment has been initiated and may not be evident until medication is discontinued. Tardive dyskinesia is characterized by rhythmic and repetitive stereotyped movements that appear to be involuntary but can usually be inhib-

TABLE 4-3

Selected Antipsychotic Drugs: Adult Doses and Side Effects.

		Dose		Side Effects		
		Antipsychotic Dose Range—Daily Oral Dosage				
Generic Name	Trade Name	Usual (mg)	Extreme (mg)*	Sedative Effects	Extrapyramidal Effects	Hypotensive Effects
1. *Phenothiazines*						
Chlorpromazine hcl	Thorazine	200–800	25–2000	+ + +	+ +	+ +
Thioridazine hcl	Mellaril	100–600	50–800	+ + +	+	+ +
Prochlorperazine	Compazine	75–100	15–150	+ +	+ + +	+
Fluphenazine hcl	Prolixin	2–10	1–25	+	+ + +	+
Trifluoperazine hcl	Stelazine	4–15	2–64	+	+ + +	+
2. *Thioxanthenes*						
Chlorprothixene	Taractan	50–400	30–600	+ + +	+ +	+ +
Thiothixene hcl	Navane	6–30	6–60	+ to + +	+ +	+ +
3. *Butyrophenones*						
Haloperidol	Haldol	2–6	1–30	+	+ + +	+

Note. Adapted from Goodman, L. S., & Gilman, A. (Eds.). *The pharmacological basis of therapeutics* (5th ed.). New York: Macmillan, 1975, pp. 170–171. Reprinted by permission.

* Extreme dosage ranges should not be exceeded except when all other appropriate measures have failed.

ited. Some of the major features are sucking and smacking movements of the lips and side to side shifts of the chin, giving the appearance of a cow "chewing its cud." The tongue may dart in and out in a "fly catching" fashion. Other symptoms include a sudden flying of the arms, up and down movements of the toes, in and out movements of the fingers or "piano playing," and jerky body movements. (See Paulson, 1975, for a detailed description of the syndrome.) Tardive dyskinesia is more common among patients who receive large dosages of major tranquilizers over extended periods. Prevalence figures for this adverse reaction range as high as 15 to 30% among psychiatric patients. At this writing, there is no one best method for treating tardive dyskinesia (Kobayashi, 1977). When the disorder appears while the person is on medication, treatment should be stopped, if possible, or another agent selected if drug therapy is necessary. For individuals who develop the disorder after treatment has been terminated, a variety of drugs which have helped some people are available. Some are benefited by resuming the drug that caused the tardive dyskinesia. The disorder can persist indefinitely after medication is terminated, but for at least half of the patients, there is gradual improvement over time after medication has been stopped.

Several large studies of drug treatment with psychotic, emotionally disturbed, and mentally retarded children have clearly documented tardive dyskinesia in children (McAndrew, Case, & Treffert, 1972; Paulson, Rizvi, & Crane, 1975; Polizos, Engelhart, Hoffman, & Waizer, 1973). Involuntary movements of the lips, tongue, and jaw are much less frequent among children than adults. *Choreiform* (ceaseless rapid and jerky involuntary movements) movements of the arms, legs, and head were the most frequently reported symptoms in children with tardive dyskinesia. For many children, the syndrome did not become apparent until medication was terminated. Off medication, some children improved over time and others became worse. Resuming drug treatment alleviated symptoms in many children who remained unchanged or became worse when drug treatment was stopped. McAndrew, Case, and Treffert (1972) reported that tardive dyskinesia was more common among children who received higher dosages for longer periods of time than among children on short term regimens at lower dosages.

There are some general differences between children and adults in the prevalence of extrapyramidal reactions (Winsberg & Yepes, 1978). The parkinsonian syndrome is most common among older adult patients and is not often observed in children. When it does occur in children, the reaction is usually mild. Acute dystonic reactions are found more often in children, and appear within 24 to 72 hours after the onset of treatment. The most common extrapyramidal syndrome in adults is akathisia which is typically seen in middle aged females. It is also reported in children, but the prevalence rate is difficult to determine. Tardive dyskinesia seems to occur with similar frequency in both children and adults, especially at higher doses. In one study of schizophrenic children receiving major tranquilizers at doses comparable to those recommended for adults, 48% exhibited neurological symptoms similar to tardive diskinesia upon withdrawal of medication (Engelhardt, Polizos, & Waizer, 1975).

DRUG USE WITH CHILDREN

Major tranquilizers have been reported to be effective in suppressing hyperactivity, aggressivity, and self injurious behavior in mentally retarded children (Freeman, 1970a; Sprague & Werry, 1971, 1974). It has been demonstrated that Mellaril and Thorazine are effective agents in controlling stereotyped behavior (Davis, 1971; Davis, Sprague, & Werry, 1969; Hollis & St. Omer, 1972). Because higher doses of the major tranquilizers can also suppress adaptive behavior and can make children less responsive to education and training, concerns have been voiced about the way in which major tranquilizers are used.

There are three good literature reviews about dose and side effects of major tranquilizers in children (DiMascio, Soltys, & Shader, 1970; Kalachnik, 1977; Winsberg & Yepes, 1978). The information presented here is a brief summary of these papers. There is a considerable range in reported dose across studies with children. The dose for Thorazine and Mellaril ranges from 10 to 1,000 mg per day with an average daily dose of 75 to 200 mg. Some clinicians prescribe one large dose at night while others divide the total amount into two or three doses during the day (Katz et al., 1975; Winsberg, Yepes, & Bialer, 1976). Most hyperactive children require no more than 50 mg or 100 mg three times per day. Relative to body weight, the average dose is 3 to 6 mg/kg per day. The effective dose of Haldol

ranges from 2 to 5 mg per day which is divided into three daily doses. It is noteworthy that significant improvements in cognitive performance have been reported with doses of Haldol as low as 0.025 mg/kg in nonretarded hyperactive boys (Werry & Aman, 1975). Daily doses for Stelazine range from 2 mg to 50 mg per day with an average of 6 to 15 mg per day. In most studies, medication is given in divided doses, usually three times per day.

Side effects of major tranquilizers in children are similar to those reported for adults. Sedative effects (drowsiness, lethargy, apathy) are quite common with Thorazine, but children usually develop a tolerance for this reaction within several days to a few weeks. Dosage reduction may be necessary in some cases. It is noteworthy that irritability and excitability are also possible. Skin reactions are not frequent. Also reported are diarrhea, upset stomach, dry mouth, and blurred vision. A number of studies report increased appetite and/or weight gains during drug treatment.

Compared to Thorazine, side effects are less frequent with Mellaril. Adverse drug reactions commonly associated with Mellaril are drowsiness, lethargy, irritability, hyperactivity, ataxia, and dizziness. Increased appetite and weight gains are also not unusual. Because Mellaril has been reported to have a favorable effect on seizure reduction, this drug can be used with some confidence for the treatment of behavior disorders in epileptic children (Kamm & Mandel, 1967).

Katz et al. (1975) stated that in their experience with hyperactive children the side effects of Mellaril were frequent and severe. Drowsiness was the most common adverse reaction that was difficult to manage. If the dose was reduced, the drowsiness was less severe but the therapeutic response was weaker. Many children developed enuresis and had to be taken off medication. Increased appetite was also common as was puffiness around the eyes and mild dry mouth. Stomach ache, nausea, and vomiting necessitated dosage reduction in a number of children. Other side effects included nose bleed, mild tremor, and *orthostatic hypotension*. Some children who reacted well to Mellaril later developed changes in temperament. They became irritable, moody, and belligerent. Medication eventually had to be stopped for these children.

Extrapyramidal syndromes are frequently reported in studies using Haldol to control behavior disorders in children. Clinicians managed these side effects by either administering an antiparkinsonian agent at the beginning of drug treatment, after symptoms appeared, or after the discontinuation of treatment. Although Haldol is usually not associated with sedative effects (see Table 4-3), drowsiness was sometimes reported in studies with children. Other side effects include nausea, ataxia, slurred speech, and weight gain.

At this point it would be desirable to provide information about the duration and termination of drug treatment for behavior disorders associated with mental retardation. Unfortunately, there are almost no data available on this topic and virtually no well controlled followup studies. TMR children who are treated for behavior disorders often are placed on medication when younger and are treated for a number of years. In fact, the median duration of treatment for children still on medication was approximately 4 years in one study (Gadow, 1978d).

ISSUES RELATING TO DRUG TREATMENT AND MENTAL RETARDATION

Psychotropic and anticonvulsant drug treatment with mentally retarded people has been the focus of controversy for several reasons. First, as pointed out above, after a review of the research on the use of psychotropic drugs with mentally retarded individuals, Sprague and Werry (1971) concluded that much of the data were of questionable value due to serious methodological flaws in most studies. Very little research has been conducted comparing drug therapy with other treatment approaches (for example, behavior modification), and there have been few published accounts about how to improve the way in which pharmacotherapy is used with mentally retarded children. Second, the manner in which these drugs are prescribed and administered (e.g., dosage, duration of treatment, monitoring) raises questions about possible drug misuse (Lipman, 1970; Sprague, 1977b, 1978). Third, recent court cases involving residential facilities for mentally retarded persons have raised serious questions about the competence of caretakers (Sprague, 1977b, 1978). Some of the major issues in these court cases are the focus on symptom suppression instead of responsiveness to treatment, overmedication, poor monitoring procedures, and a cavalier approach to record keeping about the use and effects of psychotropic drugs. Fourth, the exclusion of teachers in public schools and of direct care personnel in

residential facilities from meaningful participation in the drug regimen is also a major problem (Gadow, 1978a). Although psychotropic drugs affect the very behaviors that often become objectives in educational programing, nonmedical personnel are frequently excluded from diagnostic and drug evaluation procedures. Finally, because major tranquilizers can produce serious side effects when used for long periods of time at high dosages and can suppress adaptive behavior, disagreements about the risk-to-benefit are unavoidable. Central to this issue is whether or not medication is being used in a manner that is in the best interest of the mentally retarded child.

Less than adequate drug monitoring procedures and the use of medication as a substitute for habilitation are two major problems in this area. They have been attended to in several recent court cases. In *Wyatt* v. *Stickney*, Judge Frank M. Johnson ruled that retarded residents have a right to appropriate treatment (habilitation) which he defined as "the process by which the staff of the institution assists the resident to acquire and maintain those life skills which enable him to cope more effectively with the demands of his own person and of his environment and to raise the level of his physical, mental, and social efficiency" (*Wyatt* v. *Stickney*, 1972, p. 395). The court developed a set of standards describing what adequate habilitation of the mentally retarded person meant including a section about drug treatment. Several of the items are particularly noteworthy:

1. "Residents shall have a right to be free from unnecessary or excessive medication. The resident's records shall state the effects of psychoactive medication on the resident. When dosages of such are changed or other psychoactive medications are prescribed, a notation shall be made in the resident's record concerning the effect of the new medication or new dosages and the behavior changes, if any, that occur."
2. "Notation of each individual's medication shall be kept in his medical records . . . . At least weekly the attending physician shall review the drug regimen of each resident under his care. All prescriptions shall be written with termination date, which shall not exceed 30 days."
3. "Medication shall not be used as punishment, for the convenience of staff, as a substitute for a habilitative program, or in quantities that interfere with the resident's habilitation program."

Another case, *New York State ARC* v. *Rockefeller* (1975), resulted in a consent decree which also established standards for drug therapy. Among the guidelines were:

1. "Only appropriately trained staff shall be allowed to administer drugs."
2. "Written policies and procedures that govern the safe administration and handling of all drugs shall be developed."
3. "Medication errors and drug reactions shall be recorded and reported immediately to the practitioner who ordered the drug."

The seriousness of poor monitoring procedures is evidenced in the following quote. Sprague (1977b), serving as an expert witness for the federal judiciary, was called upon to describe and evaluate procedures employed in residential facilities for mentally retarded children. He said in part:

> I made site visits to many of the private facilities for the Office of Special Litigation, and I found intolerable conditions for many of the children. In one facility for severely retarded children, the average stay for residents was 7.8 years with 66% of the residents receiving regular anticonvulsant medication. The monitoring of this medication was almost nonexistent in that the physician supervising these patients only ordered one laboratory test to check the physical effects of the medication once in 184.3 patient-years (a patient-year is one patient in the facility for one year). (p. 146)

The importance of monitoring blood-serum level is discussed in greater detail in Chapter 3, but an example of the implications of improved monitoring procedures is cited here for emphasis. Two years after instituting an interdisciplinary pilot program to improve health care for epileptic mentally retarded residents, researchers at the Lynchburg Training School and Hospital in Virginia reported notable changes (O'Neill et al., 1977). There was a significant reduction in toxic blood levels of anticonvulsant drugs, a 48% decrease in episodes of status epilepticus, and a 73% decrease in seizure related deaths. As a result of improved monitoring procedures, 33% of the residents with uncontrolled seizures became seizure free.

An excellent model for improving monitoring procedures in residential facilities was developed at the Georgia Retardation Center in Chamblee, Georgia (Sprague, 1978). One of the more innovative aspects of the policy adopted by this facility is a multidisciplinary approach to prescribing psychotropic drugs. Before such agents are used, clear documentation must be presented demonstrating that other less restrictive techniques have failed. After passing the proposal to prescribe medication through review procedures, the team, consisting of a physician and other direct care personnel, decide if psychotropic drugs are to be administered. Through detailed monitoring procedures, side effects, suppression of maladaptive behavior, and effects on habilitation are documented.

Another major issue concerns questions about the risk-to-benefit of drug treatment. As already discussed, the courts have been quite explicit about using medication as a substitute for treatment. Nor should psychotropic or antiepileptic drugs interfere with a resident's cognitive ability to such a degree that it prevents benefit from habilitative efforts. We should not adopt an attitude that because a person is mentally retarded, impairment of learning ability is of little consequence. Although this appears transparent, statements in the literature by experts in pediatric psychopharmacology do not always give this impression as exemplified in the following quote from Millichap (1969):

> In the hyperactive mentally retarded child drugs are used primarily to facilitate management. In the child of normal intelligence it is important that the drug should have no untoward effects on learning, and the control of motor hyperactivity should be accompanied by improvement in attention, memory, perception, and coordination. (p. 1241)

Unfortunately, some mentally retarded children with severe behavior disorders cannot be treated with stimulants (Fish, 1971). In such cases, the major tranquilizers may have to be employed. Central to the issue of risk-to-benefit is the availability of effective treatments which are safe and less restrictive than drugs. At present, there is a large number of published studies using behavior modification to control aggressive, hyperactive, self destructive, and stereotyped behavior in mentally retarded persons. The reader is referred elsewhere for comprehensive reviews of this topic (Gardner, 1971; Thompson & Grabowski, 1977).

The author is aware of only one study that compared behavior modification (token reinforcement) and medication (Ritalin) in hyperactive, mentally retarded children (mean IQ of 51) (Christensen, 1975). Behavior modification was quite effective in controlling hyperactivity, and there was little difference whether or not the child was also receiving medication or placebo. Although this study supports the efficacy of behavior modification, the decision to use medication instead of behavior therapy or vice versa must be based on a number of considerations. Two of the more important in the case of behavioral therapy are the availability of competent clinicians and the cooperation of caretakers.

Perhaps one of the more difficult questions posed by parents and teachers is, "How do you know when giving medication is the right thing to do?" Considering the number of variables that influence therapeutic outcome, the inconsistencies in research results, and disagreement among experts, the reader should approach anyone who purports to know "the" truth with caution.

Although much of this discussion has focused on private and public residential facilities, information recently collected about TMR children in public schools is equally discouraging (Gadow, 1978a). In that survey, it was found that teachers received very little formal training regarding psychotropic and antiepileptic drugs even though they frequently encountered children on medication. Nor were teachers provided basic information about the effects of medication on their students' behavior. Interaction between school, parent, and physician was limited, and there was almost no direct contact between the teacher and doctor. Inadequate monitoring procedures were the result of poorly developed channels of communication, lack of standardized evaluation instruments, ambiguities in role behavior, and failure to establish drug evaluation procedures. As an example of the latter, only 19% of the children treated with psychotropic drugs for the management of behavior disorders were scheduled for a drug free period during the school year to assess the continued need for treatment. If more children participated in such breaks, it was done without the teacher's knowledge. In general, teachers were excluded from what most experts in pediatric psychopharmacology believe should be an interdisciplinary team effort. One cannot help but draw comparisons between the

standards established as a result of federal court cases and the situation that exists in the public schools.

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5/Other Disorders

There are a number of other disorders for which psychotropic and anticonvulsant drugs are prescribed but which are less common than hyperactivity or epilepsy. Those disorders, which are briefly described in this chapter, include enuresis, separation anxiety, cerebral palsy, and emotional disturbance. In this context, the latter term refers to children described as "autistic," "psychotic," and "schizophrenic." This focus on severe behavioral disturbance is quite narrow because it excludes a variety of less severe psychiatric disorders (e.g., a transient reaction to stress) for which children and adolescents receive medication.

ENURESIS

Nocturnal enuresis refers to involuntary bedwetting during sleep. The disorder is relatively common, affecting about 15% of the physically and mentally normal children at 6 years of age (Azrin & Thienes, 1978). From age 6 to 20 years, there is a decline in the prevalence of enuresis with few people bedwetting after 20 years of age. Enuresis is usually not considered a problem until a child is school age. Clinicians have arbitrarily decided that by the time a child is 6 years old something should be done (Werry, 1965). Enuresis is not usually associated with organic pathology (Forsythe & Redmond, 1974), and psychopathology is negligible (Werry, 1965). If left untreated, there is usually a spontaneous remission of sympoms—that is, the problem seems to cure itself.

In an excellent review of the literature, Blackwell and Currah (1972) stated that the tricyclic antidepressants are the only drugs that have consistently proven to be more effective than placebo for the treatment of nocturnal enuresis. Several different tricyclics are presently available, but Tofranil (imipramine) is the most commonly used for this disorder. It was first reported effective for the treatment of enuresis by MacLean in 1960, and 13 years later was approved by the FDA for use with this disorder.

When Tofranil works, the response is immediate, usually during the first week of treatment. However, a complete cure (total remission of symptoms) is reported for less than half of the children on medication. It should be noted that if a less stringent criterion is used (e.g., 50% fewer wet nights), the "success" rate is much higher. Unfortunately, "relapse tends to occur immediately following withdrawal after short periods of treatment, and long-term followup studies suggest that total remission (no wet nights) occurs in only a minority of patients" (Blackwell & Currah, 1972, p. 253).

The total daily dose of Tofranil commonly reported in the literature is 25 to 50 mg, given in one oral dose at bedtime. For children over 12 years of age, the dose may be increased to 75 mg if the smaller amount is unsuccessful. The FDA recommends that the dose of Tofranil not exceed 2.5 mg/kg/day because of the possibility of severe side effects at higher doses (Robinson & Barker, 1976).

The side effects encountered with Tofranil at doses used for enuresis are usually minor, and

children often develop a tolerance for those that do occur. The most common adverse reactions are nervousness, lethargy, drowsiness, and nausea. Abrupt cessation of medication may produce withdrawal symptoms such as nausea and headache. One of the more serious side effects is an adverse effect on the heart (cardiotoxic) at high doses (Robinson & Barker, 1976). It is for this reason that low doses (2.5 mg/kg per day or less) are recommended for enuresis. Special care should be given to storing Tofranil out of the reach of children. In the United Kingdom, tricyclic antidepressants are second only to the salicylates (e.g., aspirin) as the most common cause of death in children due to accidental poisoning (Parkin & Fraser, 1972). Typically, the drug was prescribed for an adult, either parent or neighbor, for a psychiatric disorder. However, in over a fourth of the hospital admissions due to tricyclic poisoning, the drug was prescribed for the treatment of enuresis often to children under 5 years of age.

A method that is considered by some to be more effective for enuresis than drug therapy is a battery operated buzzer and pad device, which is quite safe (Stewart, 1975). This method was first developed at the beginning of the century only to be rediscovered in the late 1930's. The child sleeps on a pad containing two foil electrodes. When a small amount of urine wets the pad, the circuit is closed, triggering an alarm that awakens the sleeping child. In principle, bladder distention becomes associated with awakening and with contraction of the bladder *sphincter* muscle. In time, the reflex to urinate during sleep is replaced with conditioned bladder control and an increased capacity to retain more urine without awakening (Mower, 1950; Stewart, 1975).

The relative efficacy of Tofranil, conditioning, and placebo were investigated in a well controlled study conducted by Kolvin, Taunch, Currah, Garside, Nolan, and Shaw (1972). Children in the study were separated into three groups, each receiving one of the aforementioned treatments. Therapy for each group lasted 2 months, with the results being evaluated 2 months later. Treatment was considered successful if there was an 80% decrease in wet nights. Using this criterion, 42% of the placebo group, 30% of the medication group, and 50% of the buzzer and pad group were considered improved. Although a number of research questions remain unanswered (Blackwell & Currah, 1972), this study demonstrates the effectiveness of both placebo and conditioning techniques for the management of enuresis as well as the existence of viable alternatives to drug therapy.

SEPARATION ANXIETY

The distress reaction shown by infants when they are separated from their mothers is referred to as separation anxiety. In theory, this reaction is not limited to infants and may be manifest in children and adolescents as school phobia and in adult *agoraphobics* as panic anxiety (Gittelman-Klein, 1975). Agoraphobics "suffer from inexplicable panic attacks, accompanied by hot and cold flashes, rapid breathing, palpitations, weakness, unsteadiness, a feeling of impending death, and occasional depersonalization. They progressively constrict their activities until they are unable to leave the house independently for fear of being suddenly rendered helpless while isolated from help" (Gittelman-Klein & Klein, 1973, p. 200). For obvious reasons this phobia is quite disabling, however, it seems to respond to Tofranil treatment. Interestingly, many adult agoraphobics also suffered from school phobia when they were younger. It was argued that drugs (i.e., Tofranil) effective for the control of panic attacks in adult agoraphobics might also be useful for the treatment of school phobia (Gittelman-Klein, 1975). A well controlled study was conducted to test this hypothesis. Subjects were selected for the study only after intense efforts were made to force the child to return to school. It was found that Tofranil was clearly superior to placebo in enabling school phobic children to attend school. When effective, medication "frees the child of panicky responses to, and morbid fears during, separation." (Gittelman-Klein, 1975, p. 266).

The average dose of Tofranil for this disorder is 75 to 100 mg/day with a maximum upper limit of 200 mg/day. Medication is often given before bed to avoid side effects (e.g., drowsiness, dry mouth). Total duration of treatment, including a gradual withdrawal period, lasts about 3 months.

Side effects in school phobic children treated with Tofranil have been found to include dry mouth, nausea, tremors, sweating, dizziness, drowsiness, lethargy, and decreased appetite (Saraf, Klein, Gittelman-Klein, & Groff, 1974).

To be truly effective, treatment must include psychotherapy as well as the cooperation of the school, family, and child. Behavioral intervention strategies should be attempted before a trial of medication. It should be noted that many chil-

dren who have a complete remission of symptoms with Tofranil later suffer relapses.

CEREBRAL PALSY

Cerebral palsy refers to a variety of nonprogressive conditions characterized by impairment of motor control which is the result of damage to the motor areas of the brain either before, during, or soon after the child is born. A number of factors can produce this damage including prenatal diseases, lack of oxygen at birth, and other birth injuries. Approximately 0.3% of the school age children in the United States have cerebral palsy (Baker, 1959). Mental retardation is common; over half of the children with cerebral palsy score 70 or below on standardized IQ tests. It is noteworthy that accurate assessment of IQ in children with cerebral palsy can be quite difficult especially if the condition is marked by severe sensory or motor impairment. Many of these children are served in special classes for mentally retarded, physically (orthopedically) impaired, or multiply handicapped students. However, the recent emphasis on least restrictive placement is bringing children with cerebral palsy into the mainstream of school activities. The motor disorders which are collectively called cerebral palsy can be subdivided into several categories, two of which (*spasticity* and *athetosis*) are pertinent to this discussion.

Neural impulses are continually transmitted from the brain to the skeletal muscles via the spinal cord. This creates a slight amount of tension (*muscle tone*) which keeps the muscle taut so it can react to stimuli more quickly. Damage to a certain area of the brain impairs normal motor control resulting in an excessive amount of muscle tension (*hypertonicity*). This condition is referred to as *spasticity*. It primarily affects the muscles responsible for bending a joint (flexor muscles) as opposed to muscles responsible for extending a joint (extensor muscles). Even slight stimulation causes the muscle to contract making the person very rigid. Motor movements are slow and spasmodic, and reflexes are often exaggerated. Deliberate efforts to control motor movements usually make things worse because the muscles tighten and become even more spastic. Spasticity is present in approximately half of the children with cerebral palsy and is more apt to be associated with mental retardation than are the other varieties of this disorder. *Athetosis* refers to the ceaseless occurrence of slow, involuntary writhing movements in the affected limb. Approximately 15 to 20% of the children with cerebral palsy have athetoid movements. Athetosis and spasticity are often concomitant.

Behavior disorders (primarily hyperactivity) and epilepsy are frequently associated with cerebral palsy. The prevalence rates for convulsive disorders range from 30 to 40% among people with cerebral palsy (Cruickshank & Raus, 1955). The relationship between IQ and epilepsy is striking in this population. One survey of individuals with cerebral palsy reported that 72% of those who were mentally retarded (IQ below 70) had epilepsy compared to 8% in the low normal range (IQ between 85 and 99) (Dunsdon, 1952).

The skeletal muscle relaxants are the most commonly prescribed drugs for the symptoms associated with cerebral palsy and are used to treat spasticity. Historically, the most significant early drug discoveries were Antodyne (noxypropanediol) in 1910 and mephenesin in 1949 (Domino, 1974). These agents were desirable because they did not produce sedation; but, unfortunately, they were eventually proven to be of little value at tolerable dosage levels. People have also observed for some time the beneficial effects of alcoholic beverages. Perlstein (1955) noted that alcohol "shows the greatest specific effect . . . in reducing tensions in cerebral palsy. . . . Many patients can walk with increasing steadiness or write a more legible letter after a cocktail" (p. 239). It was not until the 1950's, with the development of antianxiety agents, that usable drugs became available. Both the propanediols (Miltown, Equanil) and benzodiazepines (Librium, Valium) are centrally acting skeletal muscle relaxants that benefit some people with cerebral palsy. Although Valium is still used with some frequency, much work remains to be done in this area. Domino (1974) observed that Valium "is of limited value as a skeletal-muscle relaxant because it is a sedative and it is weak, even though it is clearly one of the most useful agents now available" (p. 372).

Dantrium (dantrolene sodium), a recently approved (1974) skeletal muscle relaxant, has been demonstrated as more effective than placebo in treating spasticity (Denhoff, Feldman, Smith, Litchman, & Holden, 1975). It is often difficult to demonstrate benefit from muscle relaxants due to measurement problems. Also, there is often a powerful placebo response in studies involving people with cerebral palsy. The importance of

data based procedures for evaluating the effects of muscle relaxants in habilitative settings has been advocated for some time (Phelps, 1964).

The daily dose of Valium ranges from 6 to 15 mg per day in three divided doses (Kendall, 1964). The most common side effects are lethargy, drowsiness, depression, ataxia, nausea, vomiting, and vertigo.

The daily dose of Dantrium employed by Denhoff et al. (1974) was 12 mg/kg per day divided into four doses. The side effects they reported were irritability, lethargy, drowsiness, and general *malaise*. All were transient—disappearing within a week. After the study was completed (6 weeks on medication), nine children were kept on Dantrium. Of these, four showed an increase in seizures (all were epileptic). Therefore, it was concluded that this drug may lower the convulsive threshold in some children.

Very little survey data are available on the prevalence of drug therapy for spasticity among children who have cerebral palsy. In a survey of 3,306 children in TMR programs, 22 reportedly received muscle relaxants for cerebral palsy (Gadow, 1978b). The most frequently prescribed drugs, in rank order, were Valium, Dantrium, and phenobarbital.

EMOTIONAL DISTURBANCE

Dreams, daydreams, and fantasy can be described as types of distorted and self centered thinking that bear little relationship to the real world (Ross, 1974). Such phenomena are controlled, in part, by the thinker's needs and desires. Although daydreams and fantasies are quite normal, they are maladaptive if one responds to them as reality. When this happens, a person is unable to cope with the demands of the environment and is considered psychotic. In nonverbal children, psychotic thought is inferred from the way the child behaves.

Childhood psychosis is used here as a general term to refer to severely disturbed children. It is often used to describe a variety of disorders, including "childhood schizophrenia" and "early infantile autism." The latter is a rare disorder, accounting for approximately 10% of the children diagnosed as psychotic (Rimland, 1971). Because there is little evidence that the various psychotic disorders of childhood respond more favorably to different types of drugs, diagnostic issues have not been included in this discussion.

There is considerable variability in behavioral symptoms among children diagnosed as psychotic. However, characteristics such as the following are fairly common. These children:

1. Are withdrawn, aloof, and unresponsive to adults and friends.
2. Manifest self injurious and self stimulating behavior.
3. Show stereotyped preoccupation with specific objects.
4. Have strong preference for sameness and resistance to change.
5. Engage in stereotyped motor movement (e.g., rocking, body whirling).
6. Have excessive or distorted fears even though the offending object is not present.

Speech and language disorders are typical and include *mutism*, *echolalia*, delayed development, and bizarre and meaningless speech content. The intelligence level of these children is difficult to determine but almost all score in the mentally retarded range. The prognosis for psychotic children is quite poor, and many will receive prolonged institutionalization or community care.

Because childhood psychosis is so unresponsive to treatment, it is not an exaggeration to say that almost every psychotropic and antiepileptic drug has been administered to this population. At present, no drugs "cure" these disorders, but symptom suppression is achieved in some cases. Fish (1976) described the role of medication in treatment as follows: "I believe that any child with a disorder as serious as autism deserves a trial of drug treatment. Only in much milder psychiatric conditions can social and educational measures completely resolve the symptoms and return the patient to normal functioning" (p. 108). There are several excellent reviews on this topic (Campbell, 1975a, 1975b; Fish, 1976). The following material is summarized from these articles.

Hypnotics and anticonvulsants are of no value in the treatment of childhood psychosis, and barbiturates may only aggravate the disorder. Stimulants (Benzedrine, Dexedrine, Ritalin) are generally not effective even if hyperactivity is a prominent problem. Often, these drugs make the psychotic symptoms even worse by decreasing verbal output and making the child more withdrawn. In general, the tricyclic antidepressants (Tofranil) have not proven to be effective either, and they too may make things even worse. The

hallucinogens (e.g., LSD-25) have been administered to this population as well but with limited success.

After reviewing the literature, the American Academy of Pediatrics (1976) reported that megavitamins were of little value in the treatment of childhood psychosis. Recently, however, a well controlled study demonstrated that a small percentage of autistic children might benefit from such treatment (Rimland, Callaway, & Dreyfus, 1978). Sixteen autistic children who appeared to improve in a previous study when receiving vitamin B6 (pyridoxine) were selected for a B6 and placebo comparison. The investigators reported a deterioration in symptoms for 11 of the children when placed on placebo. The dose of B6 ranged from 2.4 to 94.3 mg/kg per day; median dose was approximately 6 mg/kg per day.

Few agents have proven really helpful for psychotic children. Benadryl, an antihistamine with sedative properties, has been administered with some success in severely disturbed children (Fish, 1971). The major tranquilizers, however, are the most effective and most frequently prescribed drugs for childhood psychosis. The phenothiazines (Thorazine, Mellaril, Stelazine) have been quite effective with school age and adolescent schizophrenic children but are less desirable for young children because of side effects. Other major tranquilizers that are more "stimulating" (e.g., Haldol and Navane) have also been beneficial for some children. When effective, the therapeutic response takes the form of increased responsiveness and alertness and a brightening of mood. Some children are described as more talkative and less withdrawn. Suppression of undesirable behaviors such as stereotypy, hyperactivity, aggressivity, and self injury are also reported. Two drugs that have been studied more recently are *lithium* and *levodopa*.

Guidelines for dosage with major tranquilizers are difficult to set down since there is a great deal of variability across children. Titration is the recommended procedure, and the optimal dose in mg/kg may be *higher* than for adults. This may be explained, in part, by the fact that children metabolize many types of drugs at a faster rate than adults.

As noted in Chapter 4, side effects of the major tranquilizers must be monitored quite carefully. Even though the incidence of extrapyramidal syndromes appears to be low in young children, suppression of adaptive behavior is always a possibility. Campbell (1975b) stated that "the young child is often excessively sedated at doses that control certain psychotic symptoms. In our experience, many of these children show sleepiness and psychomotor retardation even at very low doses of chlorpromazine (Thorazine) and are not amenable to education and other treatment, irrespective of body weight and the presence or absence of hyperactivity and aggressiveness" (pp. 240–241).

Several additional comments are in order about drug management. First, children who respond favorably to one type of drug at an early age may do much better on a different medication when older. Also, the search for an effective agent may be a long and tedious process of gradually adjusting the dose and assessing therapeutic benefits. It may also require trials of several different drugs. Second, the duration of treatment may last 1 month for an acute psychotic episode or years in the case of a chronic disorder. Finally, little is known about the use of major tranquilizers with young children, therefore, careful monitoring is in order. Drug free periods should be scheduled regularly to assess the continued need for treatment.

> Once a child's development has been stimulated by using medication, and his speech or other performance has become established, these gains may continue without further medication. One does not want to introduce substances into the body unless they are really necessary. (Fish, 1976, p. 114)

MISCELLANEOUS

There are other behavior disorders for which psychotropic drugs are prescribed for children and adolescents. Kraft (1968) cited several case studies in which children and adolescents were treated with psychotropic drugs for short periods to help them cope with family illness, marital conflict, and stressful social situations.

Gilles de la Tourette's syndrome, another disorder treated with medication, is characterized by *tics* (muscle twitches or jerks) and involuntary vocalizations (Rosenthal, Nicholson, & Collier, 1975). The disorder is rare and responds to Haldol, a major tranquilizer.

A considerable amount of interest has been generated recently regarding depression in children (Conners, 1976; Rapoport, 1976), a condition some exerts report as being quite uncommon (Graham, 1974; Rutter, Tizard, & Whitmore,

1970). Although the classical pattern of depression may be rare in children (Graham, 1974), a number of child psychiatrists feel it occurs in a masked form with some frequency. A few of the presumed symptoms are hyperactivity, aggressivity, delinquency, running away from school, enuresis, nail biting, anxiety, and daydreaming. Not only is the existence of this disorder—as broadly defined—being challenged, but the role of drug therapy is also unclear. Sleator and Sprague (1978) commented that "assigning the name 'depression' to symptoms which are common to almost all psychiatric disorders of children does not automatically indicate that the antidepressant drugs are therefore appropriate therapy" (pp. 589–590).

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Appendixes

APPENDIX A

Classification of Psychotropic Drugs

Generic Name	Trade Name*
1. Stimulants	
Amphetamine	Benzedrine
Deanol	Deaner
Dextroamphetamine	Dexedrine
Levaoamphetamine	Cydril
Methamphetamine	Desoxyn
Methylphenidate	Ritalin
Pemoline	Cylert
2. Antidepressants	
Tricyclics	
Amitriptyline	Elavil, Endep
Desipramine	Norpramin, Pertofrane
Doxepin	Sinequan, Adapin
Imipramine	Tofranil, Presamine
Nortriptyline	Aventyl, Pamelor
Protriptyline	Vivactil
Monoamine Oxidase Inhibitors	
Isocarboxazid	Marplan
Phenelzine	Nardil
Tranylcypromine	Parnate
3. Minor Tranquilizers (Antianxiety Agents)	
Propanediols	
Meprobamate	Equanil, Miltown
Diphenylmethane	
Hydroxyzine	Atarax, Vistaril
Benzodiazepines	
Chlordiazepoxide	Librium
Chlorazepate	Tranxene
Diazepam	Valium
Oxazepam	Serax
4. Major Tranquilizers (Antipsychotic Agents)	
Phenothiazines	
	a. Aliphatic
Chlorpromazine	Thorazine, Sonazine
Promazine	Sparine
Triflupromazine	Vesprin

Continued on next page

Classification of Psychotropic Drugs—Continued

Generic Name	Trade Name*
	b. Piperidine
Piperacetazine	Quide
Mesoridazine	Serentil
Thioridazine	Mellaril
	c. Piperazine
Acetophenazine	Tindal
Butaperazine	Repoise
Carphenazine	Proketazine
Fluphenazine	Prolixin, Permitil
Perphenazine	Trilafon
Prochlorperazine	Compazine
Thiopropazate	Dartal
Trifluoperazine	Stelazine
Thioxanthenes	
Chlorprothixene	Taractan
Thiothixene	Navane
Butyrophenone	
Haloperidol	Haldol
Dihydroindolone	
Molindone	Moban, Lidone
Dibenzoxazepine	
Loxapine	Loxitane, Daxolin
5. Sedative—Hypnotics	
Barbiturates	
Amobarbital	Amytal
Aprobarbital	Alurate
Butabarbital	Butisol
Mephobarbital	Mebaral
Pentobarbital	Nembutal
Phenobarbital	Luminal, Eskabarb
Secobarbital	Seconal
Nonbarbiturates	
Chloral hydrate	Noctec
Ethchlorvynol	Placidyl
Glutethimide	Doriden
Methaqualone	Quaalude, Sopor
Methyprylon	Noludar
Flurazepam	Dalmane
6. Anticholinergic Drugs	
Benztropine	Cogentin
Biperiden	Akineton
Cycrimine	Pagitane
Trihexphenidyl	Artane
Procyclidine	Kemadrin
7. Other Therapeutic Agents	
Lithium Carbonate	Eskalith, Lithane Lithonate

* Only trade name products marketed in the United States are listed. In the case of drugs no longer protected by patent laws, the inclusion of trade names other than the original was arbitrary.

APPENDIX B
Conners' Abbreviated Teacher Rating Scale

Child's Name _____

Completed on _____ (date) by _____ (teacher's name)

INSTRUCTIONS:
Please consider the last _____(day, week, month) only in filling out the checklist. Check the appropriate box for each item, *Not at all*, *Just a little*, *Pretty much*, or *Very much*, which best describes your assessment of the child. Please complete all ten items.

Observation	Degree of Activity			
	Not at all 0	Just a little 1	Pretty much 2	Very much 3
1. Restless (overactive)				
2. Excitable, impulsive				
3. Disturbs other children				
4. Fails to finish things he/she starts (short attention span)				
5. Fidgeting				
6. Inattentive, distractable				
7. Demands must be met immediately; gets frustrated				
8. Cries				
9. Mood changes quickly				
10. Temper outbursts (explosive and unpredictable behavior)				

OTHER OBSERVATIONS OF TEACHERS—Use Reverse Side.

APPENDIX C

Classification of the Epilepsies*

Seizure Type†		Characteristics
I. *Partial Seizures* (Focal Seizures)	A. Partial seizures with elementary symptomatology (*cortical focal*)	Various manifestations, generally without impairment of consciousness, including convulsions confined to a single limb or muscle group (*Jacksonian motor epilepsy*), specific and localized sensory disturbances (*Jacksonian sensory epilepsy*), and other limited signs and symptoms depending upon the particular cortical area producing the abnormal discharge
	B. Partial seizures with complex symptomatology *(temporal lobe, psychomotor)*	Attacks of confused behavior, generally with impairment of consciousness, with a wide variety of clinical manifestations, associated with bizarre generalized EEG activity during the seizure but with evidence of anterior temporal lobe focal abnormalities even in the interseizure period in many cases
	C. Partial seizures secondarily generalized	
II. *Generalized Seizures* (Bilateral, Symmetrical Seizures)	A. Absences (*petit mal*)	Brief and abrupt loss of consciousness associated with high-voltage, bilaterally synchronous, 3-per-second spike-and-wave pattern in the EEG, usually with some symmetrical clonic motor activity varying from eyelid blinking to jerking of the entire body, sometimes with no motor activity
	B. Bilateral massive epileptic myoclonus	Isolated clonic jerks associated with brief bursts of multiple spikes in the EEG
	C. Infantile spasms	Progressive disorder in infants with motor spasms or other convulsive signs, bizarre diffuse changes in the interseizure EEG (hypsarhythmia), and progressive mental deterioration
	D. Clonic seizures	In young children, rhythmic clonic contractions of all muscles, loss of consciousness, and marked autonomic manifestations

Continued on next page

Classification of the Epilepsies*—Continued

Seizure Type†	Characteristics
E. Tonic seizures	In young children, opisthotonus, loss of consciousness, and marked autonomic manifestations
F. Tonic-clonic seizures (*grand mal*)	Major convulsions, usually a sequence of maximal tonic spasm of all body musculature followed by synchronous clonic jerking and a prolonged depression of all central functions
G. Atonic seizures	Loss of postural tone, with sagging of the head or falling
H. Akinetic seizures	Impairment of consciousness and complete relaxation of all musculature, secondary to excessive inhibitory discharge

Note. From Goodman, L. S., & Gilman, A. (Eds.). *The pharmacological basis of therapeutics* (5th ed.). 1975. Courtesy Macmillan Publishing Company, New York, New York.

* Modified from the International Classification of Epileptic Seizures (Gastaut, 1970).
† Some classifications include unilateral seizures as a distinct category. Additional seizure types are presently unclassified due to incomplete data.

APPENDIX D

Alphabetical List of Selected Psychotropic and Anticonvulsant Drugs by Generic Name, Trade Name, and Drug Classification

Generic Name	Trade Name*	Classification
Acetazolamide	Diamox	Anticonvulsant, Diuretic
Acetophenazine	Tindal	Antipsychotic
Amitriptyline	Elavil, Endep	Antidepressant
Amobarbital	Amytal	Sedative, Hypnotic
Amphetamine	Benzedrine	Stimulant
Aprobarbital	Alurate	Sedative, Hypnotic
Benztropine	Cogentin	Anticholinergic
Biperiden	Akineton	Anticholinergic
Butabarbital	Butisol	Sedative, Hypnotic
Butaperazine	Repoise	Antipsychotic
Carbamazepine	Tegretol	Anticonvulsant
Carphenazine	Proketazine	Antipsychotic
Chloral hydrate	Noctec	Sedative, Hypnotic
Chlordiazepoxide	Librium	Antianxiety
Chlorpromazine	Thorazine	Antipsychotic
Chlorprothixene	Taractan	Antipsychotic
Clonazepam	Clonopin	Anticonvulsant
Clorazepate	Tranxene	Antianxiety
Cycrimine	Pagitane	Anticholinergic
Dantrolene Sodium	Dantrium	Skeletal Muscle Relaxant
Deanol	Deaner	Stimulant
Desipramine	Norpramin, Pertofrane	Antidepressant
Dextroamphetamine sulfate	Dexedrine	Stimulant
Dextroamphetamine tannate	Obotan	Stimulant
Diazepam	Valium	Anticonvulsant, Skeletal Muscle Relaxant, Antianxiety
Diphenhydramine	Benadryl	Sedative, Hypnotic, Antihistamine
Diphenylhydantoin sodium	Dilantin	Anticonvulsant
Doxepin	Sinequan, Adapin	Antidepressant
Ethchlorvynol	Placidyl	Sedative, Hypnotic
Ethosuximide	Zarontin	Anticonvulsant
Ethotoin	Peganone	Anticonvulsant
Fluphenazine	Prolixin, Permitil	Antipsychotic
Flurazepam	Dalmane	Sedative, Hypnotic
Glutethimide	Doriden	Sedative, Hypnotic
Haloperidol	Haldol	Antipsychotic
Hydroxyzine	Atarax, Vistaril	Sedative, Hypnotic, Antianxiety
Imipramine	Tofranil, Presamine	Antidepressant
Isocarboxazid	Marplan	Antidepressant
Levoamphetamine	Cydril	Stimulant
Lithium Carbonate	Eskalith, Lithane, Lithonate	Antipsychotic
Loxapine	Loxitane, Daxolin	Antipsychotic

Continued on next page

Alphabetical List of Selected Psychotropic and Anticonvulsant Drugs by Generic Name, Trade Name, and Drug Classification—Continued

Generic Name	Trade Name*	Classification
Mephenytoin	Mesantoin	Anticonvulsant
Mephobarbital	Mebaral	Anticonvulsant
Meprobamate	Miltown, Equanil	Antianxiety
Mesoridazine	Serentil	Antipsychotic
Methamphetamine	Desoxyn	Stimulant
Methaqualone	Quaalude, Sopor	Sedative, Hypnotic
Metharbital	Gemonil	Anticonvulsant
Methsuximide	Celontin	Anticonvulsant
Methylphenidate	Ritalin	Stimulant
Methyprylon	Noludar	Sedative, Hypnotic
Molindone	Moban, Lidone	Antipsychotic
Nortriptyline	Aventyl, Pamelor	Antidepressant
Oxazepam	Serax	Antianxiety
Paramethadione	Paradione	Anticonvulsant
Pemoline	Cylert	Stimulant
Pentobarbital	Nembutal	Sedative, Hypnotic
Perphenazine	Trilafon	Antipsychotic
Phenacemide	Phenurone	Anticonvulsant
Phenelzine	Nardil	Antidepressant
Phenobarbital	Luminal, Eskabarb	Anticonvulsant, Sedative, Hypnotic
Phensuximide	Milontin	Anticonvulsant
Phenytoin	Dilantin	Anticonvulsant
Piperacetazine	Quide	Antipsychotic
Primidone	Mysoline	Anticonvulsant
Prochlorperazine	Compazine	Antipsychotic
Procyclidine	Kemadrin	Anticholinergic
Promazine	Sparine	Antipsychotic
Promethazine	Phenergan	Sedative, Hypnotic
Protriptyline	Vivactil	Antidepressant
Reserpine	Serpasil	Antipsychotic
Secobarbital	Seconal	Sedative, Hypnotic
Thiopropazate	Dartal	Antipsychotic
Thioridazine	Mellaril	Antipsychotic
Thiothixene	Navane	Antipsychotic
Tranylcypromine	Parnate	Antidepressant
Trifluoperazine	Stelazine	Antipsychotic
Triflupromazine	Vesprin	Antipsychotic
Trihexphenidyl	Artane	Anticholinergic
Trimethadione	Tridione	Anticonvulsant
Valproic Acid	Depakene	Anticonvulsant

* Only trade name products marketed in the United States are listed. In the case of drugs no longer protected by patent laws, the inclusion of trade names other than the original was arbitrary.

APPENDIX E

Alphabetical List of Selected Psychotropic and Antiepileptic Drugs by Trade Name and Generic Name

Trade Name*	Generic Name
Adapin	Doxepin
Akineton	Biperiden
Alurate	Aprobarbital
Amytal	Amobarbital
Artane	Trihexphenidyl
Atarax	Hydroxyzine
Aventyl	Nortriptyline
Benadryl	Diphenhydramine
Benzedrine	Amphetamine
Benztropine	Cogentin
Biperiden	Akineton
Butisol	Butabarbital
Celontin	Methsuximide
Clonopin	Clonazepam
Cogentin	Benztropine
Compazine	Prochlorperazine
Cycrimine	Pagitane
Cydril	Levoamphetamine
Cylert	Pemoline
Dalmane	Flurazepam
Dantrium	Dantrolene Sodium
Dartal	Thiopropazate
Deaner	Deanol
Depakene	Valproic Acid
Desoxyn	Methamphetamine
Dexamyl	Dextroamphetamine and amobarbital
Dexedrine	Dextroamphetamine
Diamox	Acetazolamide
Dilantin	Phenytoin
Donnatal	Belladonna alkaloids and phenobarbital
Doriden	Glutethimide
Ekko	Phenytoin
Elavil	Amitriptyline
Endep	Amitriptyline
Equanil	Meprobamate
Eskabarb	Phenobarbital
Eskalith	Lithium Carbonate
Gemonil	Metharbital
Haldol	Haloperidol
Imavate	Imipramine
Janimine	Imipramine
Kemadrin	Procyclidine
Librium	Chlordiazepoxide
Lidone	Molindone
Lithane	Lithium Carbonate
Lithonate	Lithium Carbonate
Loxitane	Loxapine
Luminal	Phenobarbital
Marplan	Isocarboxazid
Mebaral	Mephobarbital
Mellaril	Thioridazine
Meprospan	Meprobamate
Mesantoin	Mephenytoin
Milontin	Phensuximide
Miltown	Meprobamate
Moban	Molindone
Mysoline	Primidone
Nardil	Phenelzine
Navane	Thiothixene
Nembutal	Pentobarbital
Noctec	Chloral Hydrate
Noludar	Methyprylon
Norpramin	Desipramine
Pagitane	Cycrimine
Pamelor	Nortriptyline
Paradione	Paramethadione
Parnate	Tranylcypromine
Peganone	Ethotoin
Permitil	Fluphenazine
Pertofrane	Desipramine
Phelantin	Phenobarbital, phenytoin, and methamphetamine
Phenergan	Promethazine
Phenurone	Phenacemide
Placidyl	Ethchlorvynol
Presamine	Imipramine
Procyclidine	Kemadrin
Proketazine	Carphenazine
Prolixin	Fluphenazine
Quaalude	Methaqualone
Quide	Piperacetazine
Repoise	Butaperazine
Ritalin	Methylphenidate
Seconal	Secobarbital
Serax	Oxazepam
Serentil	Mesoridazine
Serpasil	Reserpine
Sinequan	Doxepin
SK-pramine	Imipramine
Sonazine	Chloropromazine

Continued on next page

Alphabetical List of Selected Psychotropic and Antiepileptic Drugs by Trade Name and Generic Name—Continued

Trade Name*	Generic Name	Trade Name*	Generic Name
Sopor	Methaqualone		
Sparine	Promazine		
Stelazine	Trifluoperazine		
Taractan	Chlorprothixene		
Tegretol	Carbamazepine		
Thorazine	Chlorpromazine		
Tindal	Acetophenazine		
Tofranil	Imipramine		
Tranxene	Clorazepate		
Triavil	Perphenazine and amitriptyline		
Tridione	Trimethadione		
Trilafon	Perphenazine		
Valium	Diazepam		
Vesprin	Trifluprornazine		
Vistaril	Hydroxyzine pamoate		
Vivactil	Protriptyline		
Zarontin	Ethosuximide		

* Only trade name products marketed in the United States are listed. In the case of drugs no longer protected by patent laws, the inclusion of trade names other than the original was arbitrary.

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Glossary

Abbreviated Teacher Rating Scale: a shortened, 10 item version of Conners' 39 Item Teacher Rating Scale (see Apendix B).

abdominal epilepsy: same as autonomic epilepsy.

aberrant: behavior that deviates markedly from what is considered normal.

absence seizure: same as petit mal seizure.

absorption: the process whereby a substance is taken into or across tissues, e.g., intestine; the movement of a drug into the bloodstream.

ACTH: adrenocorticotropic hormone.

acute: having a sudden onset and short duration.

acute dystonic reaction: characterized by uncontrolled muscle activity with stiffness or twisting of body parts; possible reactions include facial grimacing; torticollis, which may be associated with oculogyric crisis; and opisthotonos. A side effect of antipsychotic drugs occasionally seen with the initiation of treatment.

adaptive: having a capacity for modification to fit the demands of the environment.

adrenocorticotropic hormone: a hormone secreted by the anterior lobe of the pituitary gland which controls the secretion of adrenocortical hormones by the adrenal cortices; corticotropin; ACTH.

adverse reaction: same as side effect.

affective: pertaining to feelings or emotions.

affective disorders: characterized by changes in mood as the primary symptoms, e.g., mania, depression.

agitated: motor restlessness and increased activity level in association with anxiety and tension.

agitation: motor restlessness associated with mental distress.

akathisia: characterized by motor restlessness arising from a compulsion to move about; an extrapyramidal syndrome produced by antipsychotic drugs.

akinetic: cessation of movement.

akinetic seizure: a term used inconsistently in the literature to refer to the seizures associated with the Lennox-Gastaut syndrome; head nodding spells. The seizures are brief and typically consist of a sudden, violent jerk, either forward or backward. If standing the associated fall may cause severe, repeated head injury. Defined by The International League Against Epilepsy as "loss of movement without atonia" (Gastaut, 1970).

ambulatory: able to walk.

anemia: below normal number of red blood cells, amount of hemoglobin, or total drug volume.

anorexia: a lack or loss of appetite for food.

anoxia: absence or loss of oxygen.

antianxiety drug: same as minor tranquilizer.

anticholinergic: an agent that alters the effect of acetylcholine in cholinergic synapses; anticholinergic drugs are used in the management of some extrapyramidal syndromes produced by antipsychotic drugs.

anticonvulsant: an agent that reduces the frequency, magnitude, or duration of convulsions or seizures; antiepileptic.

antidepressant: an agent that prevents or suppresses the symptoms of depression; mood elevating.

antiepileptic: an agent that reduces the frequency, magnitude, or duration of convulsions or seizures; anticonvulsant.

antipsychotic: an agent that prevents or suppresses the symptoms of psychosis; major tranquilizer, neuroleptic.

anxiety: a feeling of uneasiness, apprehension, and fear over an anticipated experience.

ataxia: failure of voluntary muscle coordination; **gait ataxia**: a staggered walk with a wide base.

athetosis: characterized by slow, writhing movements of peripheral parts of the body.

atonic: loss of normal tone; **atonic seizure**: patient suddenly crumples and falls to the floor, muscles remain flaccid during the seizure.

ATRS: Abbrebiated Teacher Rating Scale.

atypical febrile convulsion: epileptic convulsion in association with a fever illess.

aura: a warning that precedes an epileptic seizure often manifest as a sensation or motor movement.

autism: a subjective, self centered form of thinking that is not correctable with information from external reality.

automatisms: seemingly, puposeful involuntary behavior that is out of context; a manifestation of psychomotor epilepsy; **simple automatisms**: repetitive smacking of lips, chewing, mumbling; **complex automatisms**: undressing, walking about.

autonomic nervous system: the part of the nervous system that regulates the muscles of the heart, smooth muscles, and glands.

autonomic epilepsy: an uncommon form of epilepsy in which seizures may be manifest as gastrointestinal disturbances (abdominal pain, vomiting, nausea, etc.), headache, or other symptoms of autonomic dysfunction; thalamic epilepsy, abdominal epilepsy, epileptic equivalent.

behavior modification: a treatment approach based on a model that views abnormal behavior as being acquired in response to environmental stress and learned and maintained in the same manner as normal behavior. The principles of experimental psychology are emphasized, particularly classical and operant conditioning. The importance of the cognitive mediation of behavior and vicarious and symbolic learning processes, e.g., modeling, is also recognized. Treatment conditions are explicitly stated and therapeutic outcomes are measured objectively.

behavior therapy: same as behavior modification.

benign: having a favorable outcome; not recurring.

benzodiazepines: a category of antianxiety agents (minor tranquilizers) which includes diazepam (Valium), chlordiazepoxide (Librium), and clonazepam (Clonopin).

bilateral: pertaining to both sides.

biotransformation: the chemical alteration of a compound within the body, e.g., the metabolism of a drug by liver microenzymes.

blood brain barrier: refers not to an anatomical structure but to the fact that the capillaries of the brain prevent certain classes of compounds from entering and affecting brain neurones. A closeknit layer of glial cells surrounds the brain capillaries creating an additional barrier for compounds which are not lipid soluble.

brand name: same as trade name.

butyrophenones: a category of antipsychotic agents (major tranquilizers) which includes haloperidol (Haldol).

cardiovascular: pertaining to the heart and blood vessels.

central nervous system: consisting of the brain and spinal cord.

cerebral palsy: a variety of syndromes, characterized by a disorganization of motor control, that are the result of damage to the motor areas of the brain.

chorea: characterized by continuous, random, uncontrolled contractions of different muscle groups.

chronic: persisting over a long period of time.

clonic: pertaining to a series of alternate muscle contractions and relaxations.

coarse facies: marked by swelling of the lips, thickening of the subcutaneous tissue of the face and scalp, and broadening of the nose; adverse reaction associated with phenytoin (Dilantin) treatment.

cognitive performance: performance on a specified task generally regarded to measure perception, thinking, and remembering.

colic: acute abdominal pain.

combined drug regimen: the simultaneous treatment of two or more disorders with different drugs.

concomitant: accompanying; joined with another.

convulsion: a violent and involuntary contraction or series of contractions of the voluntary muscles.

convulsive disorder: recurrent seizures; epilepsy.

convulsive threshold: the point at which a stimulus, e.g., electrical discharge, produces a convulsion or seizure.

corticotropin: same as adreocorticotropic hormone.

deinstitutionalization: the transfer of individuals (e.g., mentally retarded, mentally ill) from institutional or residental care to community placements (e.g., half way houses, group ho[illegible].

delusions: a false belief that cannot be changed by reason or evidence from the patient's own senses.

depression: a psychiatric disorder characterized by feelings of personal incompetence, listlessness, insomnia, loss of appetite, and psychomotor slowing.

dermatitis: inflammation of the skin.

diphenylmethanes: a category of antianxiety agents (minor tranquilizers) which includes hydroxyzine hydrochloride (Atarax) and hydroxyzine pamoate (Vistaril).

diplopia: double vision.

distribution: the movement of drug molecules in the bloodstream to the site of drug action; concentration of drug molecules in body compartments.

diuretic: an agent that promotes the secretion of urine.

dose: amount of medication administered.

double blind: characterizing a study of a particular treatment, e.g., drug, in which neither the person administering (evaluating) or receiving the agent is aware of whether the active or inactive (placebo) drug is being given.

drug: any substance other than food that has an effect on living tissue.

drug addiction: "A behavioral pattern of compulsive drug use, characterized by overwhelming involvement with the use of a drug, the securing of its supply, and a high tendency to relapse after withdrawal" (Jaffe, 1975, p. 285).

drug free period: a break in a chronic drug regimen for a period of time during which no medication is administered; drug holiday.

drug holiday: same as drug free period.

drug interaction: the modification of the effects of a drug by the prior or concurrent administration of another drug.

drug of (first) choice: the agent to be administered first in the treatment of a specific disorder, usually determined on the basis of safety and efficacy.

dysarthria: imperfect articulation of speech; slurred speech.

dyskinesia: fragmentary or incomplete movements that result from a diminished power to control voluntary movements.

dystonia: disordered muscle tone.

early infantile autism: a rare disorder with onset during early infancy and characterized by autistic aloneness, absence of language or developmental language disorders, insistence on sameness, repetitive behaviors, and lack of demonstrable physical defect.

echolalia: the reptition of words spoken by other people as if echoing what is said.

edema: swelling resulting from an accumulation of fluid in subcutaneous tissues.

educable mentally retarded: an educational classification for children whose IQ's range from 50 or 55 to 75 or 80.

EEG: electroencephalogram.

efficacy: effectiveness.

electroencephalogram: a recording of the electrical current spontaneously generated by the cells in the brain.

EMR: educable mentally retarded.

endocrine system: the glands and structures that produce hormones which are released into the blood.

endoplasmic reticulum: ultramicroscopic network of tubules and cavities within almost all cells; microenzymes in the endoplasmic reticulum of liver cells break drugs down into metabolites that are more easily removed from the body.

enuresis: involuntary discharge of urine.

enzyme: a protein that brings about or accelerates chemical reactions.

epidemiology: the study of the factors that influence the incidence, distribution, and control of disease.

epilepsy: recurrent seizures that are due to sudden electrical discharges in the brain.

epileptic equivalent: same as autonomic epilepsy.

epileptic seizure precipitated by fever: form of

epilepsy characterized by seizures that are triggered by a fever illness.

equilibrium: a state of balance between two opposing forces.

etiology: the causes of a disease; the study of the factors that cause disease.

exacerbate: to make more severe or violent.

excretion: the elimination or discharge of substances, e.g., wastes, metabolites, from the cell, tissue, and blood; drugs are often excreted as water soluble metabolites by the kidney.

extensor: a muscle that extends a joint.

extracellular fluid: fluid outside the cell.

extrapyramidal syndromes: a group of disorders characterized by abnormal involuntary movements. Extrapyramidal syndromes produced by antipsychotic drugs include parkinsonian syndrome, akathisia, acute dystonic reaction, and tardive dyskinesia.

extrapyramidal tract: not an anatomical structure, but a group of nuclei (a nucleus is a mass of nerve cells) and fibers that control and coordinate motor activities, especially gross intentional movements, patterns of movement, walking movements, and "background" muscle tone.

FDA: Food and Drug Administration.

febrile: relating to or characterized by fever.

Feingold diet: same as Kaiser-Permanente diet.

flexor: any muscle that bends a joint.

focal epilepsy: characterized by seizures associated with an abnormal electrical discharge originating in, or restricted to, a limited area of the brain.

folic acid: substance used by the bone marrow to form red blood cells.

gastrointestinal: pertaining to the stomach and intestines.

generalized seizures: seizures associated with abnormal electrical discharges that affect the entire brain; they may be focal at the onset and spread to become generalized or be generalized from the beginning. Grand mal, petit mal, and myoclonic seizures are all generalized seizures.

generic name: a drug name, not protected by a patent, that identifies a specific chemical structure; official name, nonproprietary name.

Gilles de la Tourette's syndrome: a rare disorder with an onset in childhood characterized by tics, particularly of the facial muscles, and involuntary vocalizations.

gingival hyperplasia: an excessive growth of gum tissue with a mulberry shaped appearance. Irritants lodged in the tissue cause secondary inflammation resulting in a red or bluish-red discoloration. This is an adverse reaction commonly associated with phenytoin (Dilantin).

gonadotropic hormones: Three hormones secreted by the anterior pituitary that have an influence on the ovaries and testes.

grand mal epilepsy: characterized by periodic attacks of unconsciousness and generalized tonic and clonic movements frequently lasting from 3 to 5 minutes. Interseizure EEG findings may be normal and seizures can begin at any age. Generalized seizures fall into four catgories: Tonic-clonic, clonic, tonic, and atonic.

growth rebound: an increase in growth rate following the cessation of stimulant drug treatment in hyperactive children.

hallucination: perception of an object in the absence of corresponding stimuli.

hallucinogens: a category of psychotropic drugs capable of inducing hallucinations.

hirsutism: abnormal hairiness; an adverse drug reaction associated with phenytoin (Dilantin) therapy.

hydantoinates: a category of antiepileptic drugs with potent anticonvulsant properties that includes phenytoin (Dilantin), mephenioin (Mesantoin), and ethotoin (Peganone).

hyperactivity: a long term, persistent behavior disorder characterized by excessive restlessness and inattentiveness originating during early to middle childhood (2 to 6 years of age).

hypertonicity: characterized by excessive skeletal muscle tone; the muscle is more resistant to passive stretching.

hypnotic: a category of psychotropic drugs that induce sleep.

hypotension: abnormally low blood pressure.

hypothalamic epilepsy: same as autonomic epilepsy.

hypsarythmia: an exceedingly abnormal electroencephalographic pattern between seizures characterized by random, high voltage slow waves and spikes that originate from multiple foci and spread to all cortical areas. This EEG pattern is associated with myoclonic epilepsy of young children (infantile spasms, salaam

seizures, massive myoclonia). Severe mental retardation is common.

idiopathic: a disease of spontaneous origin or unknown cause.

incidence: the number of new cases, e.g., of a disease, during a certain period of time.

infantile spasms: same as myoclonic epilepsy of young children.

induce: to bring about by stimulation; cause something to occur.

insomnia: inability to sleep.

intracellulor fluid: fluid within the cell.

intractable: resistant to control.

intramuscular: within the substance of the muscle.

intravenous: within a vein.

in utero: within the uterus.

Isle of Wight: island off the southern coast of England.

Jacksonian seizure: a focal seizure characterized by unilateral clonic movements that start in one group of muscles moving systematically to adjacent groups of muscles. The seizures are due to an abnormal electrical discharge that originates in, and spreads across, the motor cortex.

jaundice: a syndrome characterized by an excess of bile pigment in the blood and yellow appearance of the skin resulting from the deposition of bile pigments in the skin; icterus.

Kaiser-Permanente diet: a treatment regimen for childhood behavior disorders, especially hyperactivity, which involves the elimination of low molecular weight chemicals, e.g., salicylates and artificial colors and additives, from daily food intake; K-P diet, Feingold diet.

ketogenic diet: a dietary regimen in which the total daily consumption of fat (in grams) is at least four times greater than proteins and carbohydrates combined (in grams). This maintains the state of ketosis achieved by a marked reduction in food intake at the onset of treatment. The diet is effective in treating myoclonic epilepsy in young children.

kg: kilogram.

kilogram: a unit of weight in the metric system being 1000 grams; equivalent to approximately 2.2 pounds.

K-P diet: same as Kaiser-Permanente diet.

learning performance: performance on a specified task generally regarded to measure learning rather than a more pure measure of the neural events associated with learning.

least restrictive alternative: handicapped children, including children in public and private institutions, are educated as much as possible with children who are not handicapped. Separate schools, special classes, or other removal of any handicapped child from the regular program is appropriate only if the regular educational environment accompanied by supplementary aids and services is not adequate to give the child what he or she needs.

Lennox-Gastaut syndrome: one type of myoclonic epilepsy characterized by several types of seizures including staring spells, myoclonic seizures (sudden violent jerks with an associated fall, sudden falls without jerks, head nodding seizures, and sagging attacks (atonic seizures), and generalized tonic-clonic seizures. Age of onset is usually between 3 to 5 years of age. Mental and motor retardation are common. Interseizure EEG findings often show modified hypsarhythmia (2 per second spike and wave). Also called petit mal variant, myoclonic epilepsy of older children.

lipids: a group of substances, such as fatty acids, that cannot be dissolved in water. Lipids are stored in the body, are used as fuel, and are an important part of all living cells.

lipid soluble: capable of being dissolved in lipids.

mainstreaming: an approach to the delivery of special education services that emphasizes the integration of the handicapped child with nonhandicapped peers in regular classrooms as opposed to segregation in self contained special classes. The educational needs of the child are met through modifications in the regular school program.

major motor epilepsy: same as grand mal epilepsy.

major tranquilizer: a category of psychotropic drugs that includes the phenothiazines, thioxanthenes, and butyrophenones; antipsychotic agents, neuroleptics. These drugs are used primarily in the treatment of psychotic disorders.

maladaptive: not promoting or assisting adaptation.

malaise: an indefinite feeling of bodily discomfort or lack of health.

MAO inhibitor: same as monamine oxidase inhibitor.

massive myoclonic seizures: same as myoclonic epilepsy of young children.

mcg: microgram.

μcg: microgram.

mcg/ml: microgram per milliliter.

μcg/ml: microgram per milliliter.

MCT: medium chain triglycerides.

megavitamins: massive doses of vitamins. A treatment of questionable efficacy for learning disabilities, hyperactivity, adult psychosis, and convulsions consisting of large doses of niacin, niacinamide, ascorbic acid, pyridoxine, and calcium pantothenate or other vitamins either individually or in combination. Possibly effective in the treatment of childhood psychosis.

mental retardation: "Significantly subaverage general intellectual functioning existing concurrently with deficits in adaptive behavior, and manifested during the developmental period" (Grossman, 1973, p. 11). Classification according to the severity of symptoms (IQ score) is as follows: mild (55–69), moderate (40–54), severe (25–39), and profound (below 25). The terms *borderline*, *dull-normal*, and *slow learning* are occasionally used to refer to children with IQ's from 75 to 89.

metabolism: the sum of the processes in the building up and maintenance of living substance and the production of energy for vital activities; the sum of the processes by which the body transforms a substance, e.g., drug.

metabolite: any substance produced by a metabolic process.

mg: milligram.

mg/kg: milligram per kilogram.

microgram: a unit of weight in the metric system being one one-millionth of a gram or one one-thousandth of a milligram.

microsomal enzymes: enzymes within the cells of the liver that participate in the metabolism of many drugs.

migraine: a condition marked by periodic attacks of severe headaches often associated with nausea and vomiting. The attacks are preceded by constriction of cranial arteries and begin with the dilation of the arteries.

milligram: a unit of weight in the metric system being one one-thousandth of a gram; equivalent to approximately one twenty-eight thousandth of an ounce.

milliliter: a metric unit of capacity being one one-thousandth of a liter.

minimal brain dysfunction: a syndrome found "in children of near average, average, or above average general intelligence" and characterized by "learning or behavioral disabilities ranging from mild to severe, which are associated with deviations of function of the central nervous system. These deviations may manifest themselves by various combinations of impairment in perception, conceptualization, language, memory, and control of attention, impulse, or motor function . . ." (Clements, 1966, p. 9–10).

minor tranquilizer: a category of psychotropic drugs with sedative and antianxiety properties which includes the benzodiazepines, propanediol carbamates, and hydroxyzine.

mixed epilepsy: two or more different types of epilepsy manifest at the same time.

ml: milliliter.

monoamine oxidase inhibitor: a category of antidepressant drugs that includes tranylcypromine (Parnate) and phenelzine (Nardil).

motor cortex: the area of the brain that controls discrete movements of the skeletal muscles.

muscle tone: a slight degree of muscle tension produced by continuous neural stimulation.

mutism: inability or refusal to speak.

myoclonic epilepsy: consists of several different types of epilepsy including myoclonic epilepsy of young children (infantile spasms, West syndrome) and myoclonic epilepsy of older children (Lennox-Gastaut syndrome, petit mal variant), both of which appear to be the same disorder but with different age at onset of seizures. Classification of the other types of myoclonic epilepsy is incomplete but includes children and adolescents with myoclonic seizures who do not manifest the symptoms associated with infantile spasms or the Lennox-Gastaut syndrome.

myoclonic epilepsy of older children: same as Lennox-Gestaut syndrome.

myoclonic epilepsy of young children: characterized by brief (several seconds) myoclonic seizures that usually occur in clusters lasting several minutes and abnormal interseizure EEG findings called hypsarhythmia. Onset of seizures is commonly between 3 and 9 months of age. Severe mental retardation is common. Also called infantile spasms, West syndrome.

myoclonic seizure: flexor spasm of the musculature; extensor spasms much less common.

narcolepsy: a condition characterized by an uncontrollable desire to sleep or periodic attacks of deep sleep.
neuroleptic: same as antipsychotic agent.
neuropharmacology: the branch of pharmacology that investigates the effects of drugs on the nervous system.
nocturnal: pertaining to night.
nonproprietary name: same as generic name.
nystagmus: a rapid involuntary movement of the eyeball either horizontally, vertically, or in a rotatory manner.

oculogyric crisis: fixed upward gaze; a symptom associated with acute dystonic reaction, an extrapyramidal syndrome produced by some antipsychotic drugs.
official name: same as generic name.
opiates: a group of drugs consisting of opium and its derivatives.
opisthotonos: a type of muscle spasm in which the back is arched, head and heels are bent backward, and the body bowed forward.
organic: pertaining to, or arising from, the organs; affecting the structure of an organism.
organic epilepsy: epilepsy that develops subsequent to permanent, nonprogressive damage to the brain, e.g., head trauma, brain infections.
orthopedic: pertaining to the correction of musculoskeletal deformaties; marked by crippling.
orthostatic hypotension: weakness or fainting on rising to an erect position.
osteomalacia: a condition that results from vitamin D and calcium deficiency characterized by softening of the bones, pain, anorexia, and muscular weakness.
oxazolidinediones: a category of antiepileptic drugs that includes trimethadione (Tridione) and paramethadione (Paradione).

panic anxiety: a psychiatric disorder characterized by recurrent and unexplained panic attacks with feelings of impending doom. The attacks may be associated with physical symptoms such as breathing difficulties or heart palpitations.
parkinsonian syndrome: an extrapyramidal syndrome characterized by psychomotor slowing, masklike facial expression, shuffling gait without free swing of the arms, rigidity, and tremor. "Pill rolling" movements may also be present. An adverse reaction associated with antipsychotic drug therapy.
parenteral: administration by a route other than the digestive tract; any of several routes of injection including subcutaneous, intramuscular, and intravenous.
pathognomonic: characteristic of a disease; a sign or symptom that is used to make a diagnosis.
pathology: the study of the structural and functional changes in tissues and organs of the body that are caused by disease; deviations from the normal that characterize disease.
pediatric psychopharmacology: the branch of pharmacology that investigates the behavioral effects of drugs in children.
petit mal epilepsy: characterized by periodic attacks of altered consciousness usually lasting from 5 to 30 seconds. The seizure is manifest as a sudden cessation of movement and vacant staring into space. In some children the eyes roll back into the head. Seizures may be associated with brief clonic movements that usually recur at a frequency of 3 per second or automatisms. An EEG finding of 3 per second spike-wave forms is pathognomonic of petit mal epilepsy.
petit mal variant: same as Lennox-Gastaut syndrome.
pharmacology: the science that deals with the chemical properties, biochemical and physiological effects, absorption, distribution, biotransformation, excretion and therapeutic uses of drugs.
pharmacotherapy: the treatment of disease with medicines.
phenothiazines: a group of antipsychotic drugs which includes chlorpromazine (Thorazine) and thioridazine (Mellaril).
phobia: a persistent abnormal fear.
photophobia: abnormal intolerance to light.
photosensitivity: abnormal reaction of the skin to sunlight.
pigmentation: an abnormal increase of coloration by melanin.
pill rolling: as if rolling a pill between the fingers; a symptom of parkinsonian syndrome.
placebo: an inactive medication administered to satisfy a patient's need for drug therapy; an inert substance used to control for expectancy effects in pharmacological research; a procedure with no intrinsic therapeutic value.
polypharmacy: the simultaneous administration of two or more drugs for the same disorder.
post convulsive phenomena: disturbances following the active stages of a seizure including

weakness, nausea, fatigue, muscle soreness, headache, irritability, confusion, and abnormal behavior.

post convulsive sleep: period of deep sleep following a seizure.

prevalence: total number of cases in a specific area during a certain period of time.

prolonged seizure: an individual seizure lasting for an uncharacteristically long time.

propanediols: a group of antianxiety agents that includes meprobamate (Equanil, Miltown); propanediol carbamates.

prophylaxis: preventive treatment.

proteins: any one of a group of complex compounds consisting of a combination of amino acids; the principal constituents of all living cells.

psychic seizures: a type of psychomotor seizure manifest as changes in perception, thought, self awareness, mood, or affect.

psychomotor: relating to muscular actions resulting from conscious mental activity.

psychomotor epilepsy: characterized by periodic attacks of altered consciousness lasting from one to several minutes. Seizures may be manifest as a cessation of movement starting with or without automatisms or as changes in perception, thought, self awareness, mood, or affect. EEG findings usually show interseizure temporal lobe abnormalities. Also called temporal lobe epilepsy.

psychomotor slowing: manifest as an inability to respond spontaneously at a normal speed, weak voice and labored speech, deliberate body movements, fixed facial expression, and a slowed, dragging walk.

psychopathology: mental disorders; the study of such dysfunctions.

psychopharmacology: the branch of pharmacology that investigates the effects of drugs on behavior.

psychosis: a general term for any severe mental disorder involving a loss of contact with reality and usually associated with delusions, hallucinations, or illusions.

psychotropic drug: any agent that has its principal effect on mood, thought processes, or behavior; behavior modifying drug.

rebound effect: reaction to the withdrawal of medication that may be manifest as an aggravation of the symptoms of the disorder being treated.

refractory: unresponsive to treatment.

relapse: a return of a disease after it apparently ceased.

remission: the lessening or cessation of the symptoms of a disease.

rickets: a condition that results from vitamin D deficiency characterized by bending or distortion of the bones.

salicylates: a group of drugs with analgesic, fever reducing, and anti-inflammatory properties, e.g., aspirin.

schizophrenia: a psychotic disorder characterized by emotional distortion, ambivalence, disturbances of thought, retreat from reality, delusions, hallucinations, and withdrawn or bizarre behavior.

secondary epilepsy: same as organic epilepsy.

sedative: a category of psychotropic drugs that reduce excitement and have a calming effect.

seizure: a sudden attack; fit. **Epileptic seizure:** a loss or alteration of consciousness associated with involuntary muscle movement (or cessation of movement) and abnormal electrical discharges in the brain; convulsion, spell, fit.

self limiting: limited by its own nature and not by outside influences. Self limiting side effects run a limited course and terminate on their own.

separation anxiety: apprehension resulting from loss of contact with significant persons or familiar surroundings; common in infants 6 to 10 months old.

serial grand mal (major motor) seizures: characterized by recurrent grand mal seizures during which the person regains consciousness between attacks; frequently associated with the abrupt withdrawal of anticonvulsant medication.

side effect: a consequence other than that for which an agent or treatment is being used; adverse reaction, toxic effects, untoward reaction.

simple febrile seizure: a benign, nonepileptic disorder characterized by brief generalized seizures that occur usually 2 to 6 hours after the onset of a fever. The disorder rarely lasts beyond 6 years of age.

spasm: a sudden and involuntary muscle contraction.

spasticity: increase over normal muscle tone; hypertonicity.

sphincter: a muscle that forms a ring around a

body opening, e.g., urethra, and prevents passage via constriction.

spontaneous: occuring without external influence; voluntary.

status epilepticus: a series of seizures in succession during which the person does not regain consciousness between attacks; usually refers to grand mal status.

status seizure: a series of recurring seizures during which the patient does not regain consciousness between seizures.

stereotyped behavior: repetitive and often bizarre motor movements such as rhythmic rocking, head weaving, hand or arm flapping, and rubbing parts of the body; stereotypies.

stereotypies: same as stereotyped behavior.

stimulant: a category of psychotropic drugs that includes methylphenidate (Ritalin), dextroamphetamine (Dexedrine) and pemoline (Cylert).

subcutaneous: beneath the skin.

succinimides: a category of antiepileptic drugs particularly effective in the treatment of petit mal epilepsy that includes ethosuximide (Zarontin), methsuximide (Celontin), and phensuximide (Milontin).

symptomatic epilepsy: seizures are one of the symptoms of a specific disorder that involves the brain, e.g., cerebral generative disease.

syndrome: a set of symptoms that occur together and characterize a specific disorder.

tardive dyskinesia: a late appearing extrapyramidal syndrome characterized by involuntary, repetitive movements usually in the region of the mouth but may involve the limbs and trunk as well. Movements include tongue protrusion, licking or smacking of the lips, side to side movements of the chin, blowing of the cheeks, facial grimacing, and eye blinking. A side effect of long term antipsychotic drug treatment.

temporal lobe epilepsy: same as psychomotor epilepsy.

thiozanthenes: a category of antipsychotic agents that includes chlorprothixene (Taractan) and thiothixene (Navane).

teratogen: a substance that causes physical defects in the developing embryo.

tic: spasmodic movement of a muscle; a twitching movement especially of a facial muscle.

titration: a method for determining the strength of a solution or the concentration of a substance in solution; used metaphorically to describe a procedure for adjusting the dose of a drug. The initial dose, usually too small to produce a therapeutic response, is gradually increased over time until the desired effect is achieved or unacceptable adverse reactions appear.

TMR: trainable mentally retarded.

tolerance: a lessened susceptability to the effects of the same dose of a drug over repeated administrations.

tonic: characterized by continuous tension. The tonic phase of a grand mal seizure is marked by boardlike rigidity.

torticollis: characterized by contracted cervical muscles resulting in a twisting of the neck and unnatural positioning of the head. A symptom of an acute dystonic reaction, an extrapyramidal syndrome associated with antipsychotic drugs.

toxic: poisonous; causing disturbance of body function or structural damage to organs and tissues.

toxic reaction: same as side effect.

trade name: a brand name protected by trademark laws which restrict use to the original copyright holder indefinitely; nonproprietary name, unofficial name. The trade name of a drug refers to a particular formulation of a generic drug made by a specific manufacturer.

trainable mentally retarded: an educational classification for children whose IQ's range from 25 or 35 to 50 or 55.

trauma: a wound or injury.

tremor: an involuntary trembling or shaking.

tricyclics: a category of antidepressant drugs that includes imipramine (Tofranil), amitriptyline (Elavil), and nortriptyline (Aventyl).

unilateral: affecting but one side.

untoward reaction: same as side effect.

urticaria: a skin reaction marked by patches of skin either redder or paler than the surrounding skin, usually associated with severe itching, and often caused by emotional stress or certain foods, drugs, or infections; hives.

vitamin D: a substance that greatly accelerates the absorption of calcium from the gut.

water soluble: capable of being dissolved in water.

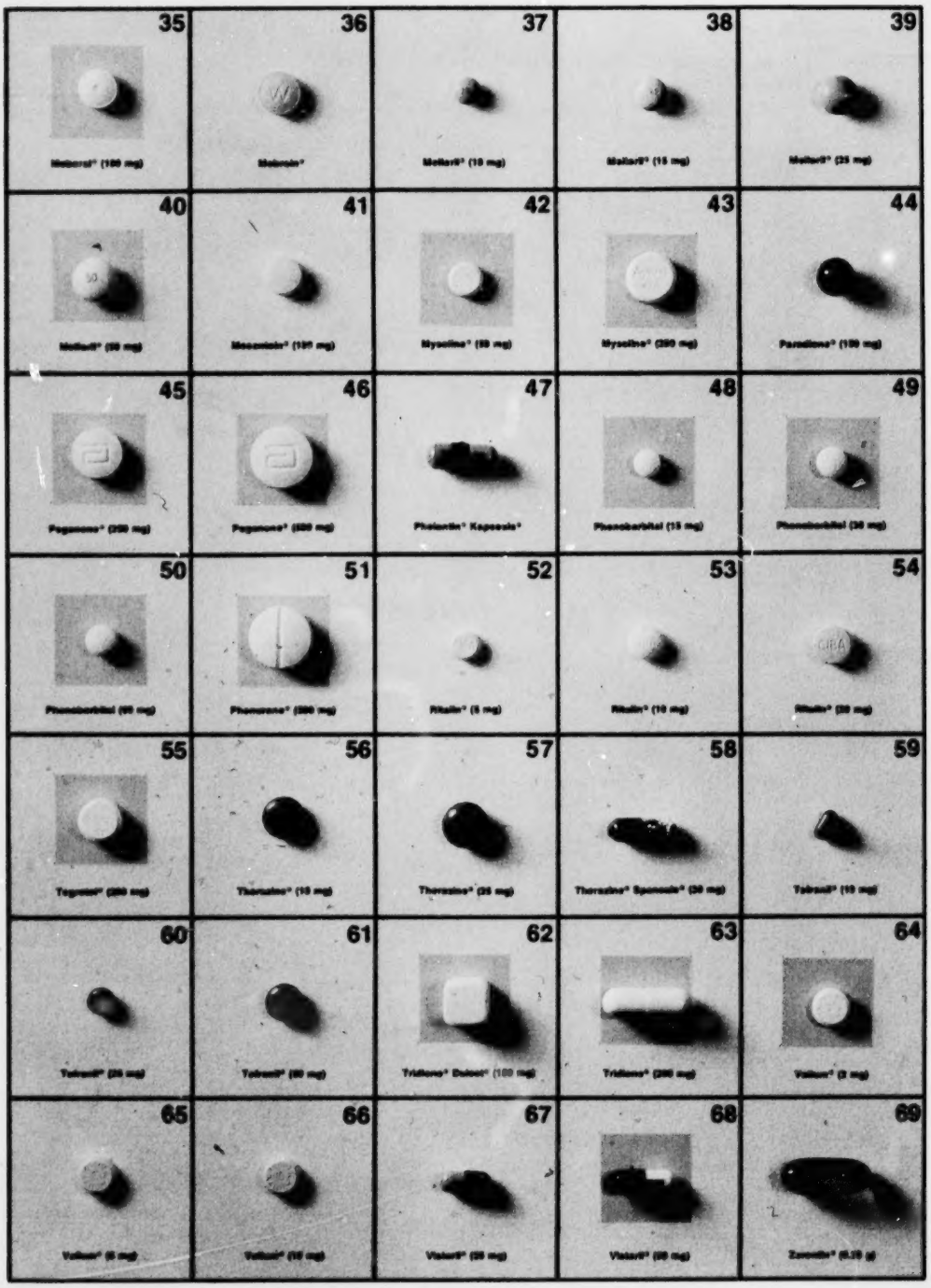
withdrawal syndrome: characteristic symptoms associated with the withdrawal of a specific drug.

REFERENCES

Dorland's Illustrated Medical Dictionary (25th ed.). Philadelphia: Saunders, 1974.

Children's Medication Chart

Continued from inside front cover



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